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GENERAL SCIENCE QUARTERLY

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NUMBER 4

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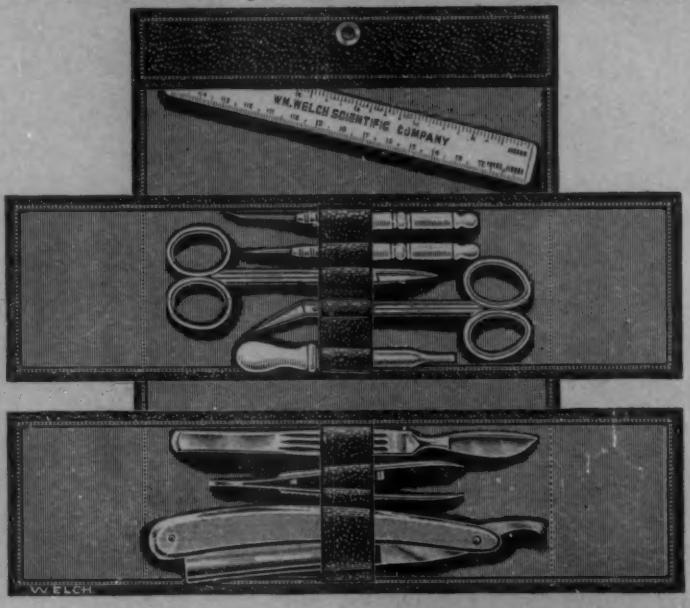

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Vol. XII MAY, 1928 No. 4

An Analysis of Textbooks in General Science

Overn, Iler and Heinemann.

Elliot R. Downing, Editor
School of Education, University of Chicago

In 1921 O. E. Overn completed an analysis of twelve textbooks in general science including his results in a thesis for the Master's degree. Mr. Ernest Iler analyzed 13 additional texts also in work for a Master's degree, 1927. Mrs. Ailsie Heinemann analyzed twenty texts in terms of the principles of science treated.[1] This material seems too valuable to lie unpublished. The author of the article is serving largely in the capacity of editor, the credit for the data included in the tables is largely due to the three persons mentioned. The author is responsible for the summaries and for the interpretations.

The subject matter of these twenty-five texts was analyzed first on the basis of twenty large topics sub-divided into 131 minor topics. The twenty large topics chosen are not those selected by all authors of the books as the titles of their units or chapters, although each of these large topics is so used by several of the authors. There was such diversity in the chapter or unit titles that it was necessary to select such a group of large topics as was chosen for the basis of the analysis.

The author has drawn to scale on the basis of the page space a graphic presentation of the analysis of the twenty-five books showing not only the total space devoted to each of the large topics but also the space devoted to them by each author. Numbering the topics from one to twenty in the order given in the graph from No. 1 occupying the largest space to No. 20 occupying the least, there is presented below Table I, show-

1 An article covering this analysis will be published in the November, 1928, Quarterly.

ing also the order of these twenty large topics in the earlier books analyzed by Overn, all of which bore a date prior to 1920, and the later books analyzed by Iler. If these twenty large topics are divided into two groups of ten each, the major topics receiving the largest amount of page space and the minor topics receiving less page space, it will be noted that only one of the minor topics of Overn's analysis—namely,

TABLE I

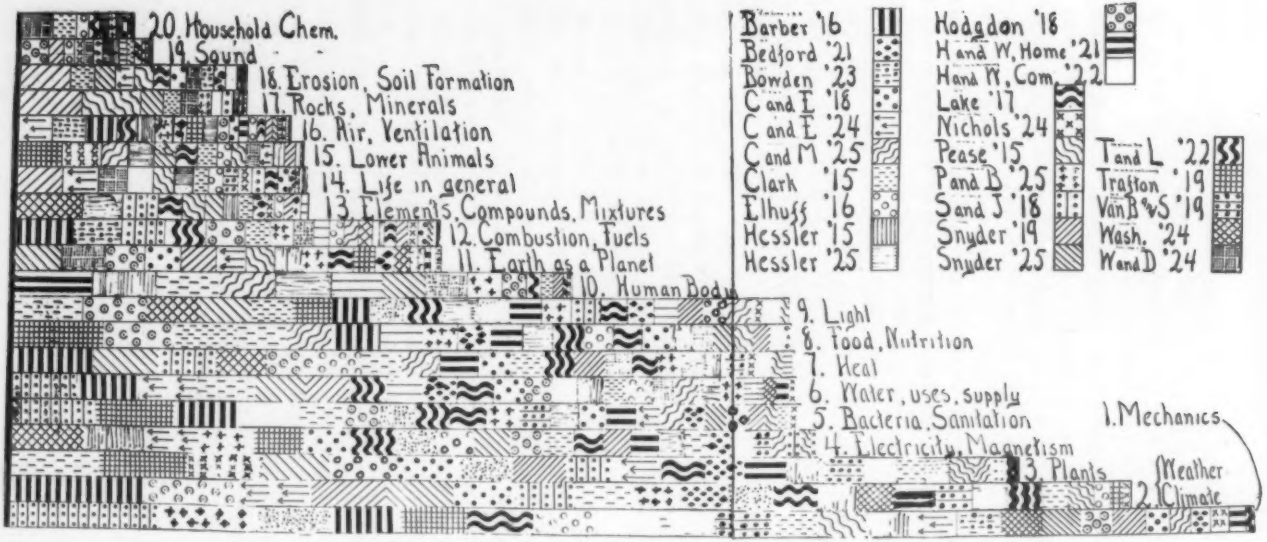
Showing the order of major and minor topics in the twenty-five texts, measured in word space; also in the twelve preceding 1920 analyzed by Overn and the thirteen, 1920 or after, by Iler.

Order of all 25		Overn	Iler
1	Mechanics	1	1
2	Weather and climate	2	3
3	Plants	3	2
4	Electricity and magnetism	9	4
5	Bacteria and sanitation	5	9
6	Water, uses, supply	7	7
7	Heat	6	8
8	Food, nutrition	4	10
9	Light	8	6
10	Human body	15	5
11	Earth as a planet	11	11
12	Combustion, fuels	10	12
13	Elements, compounds, mixtures	13	15
14	Life in general	12	16
15	Lower animals	16	14
16	Air, ventilation	18	13
17	Rocks, minerals	14	18
18	Erosion, soil formation	17	17
19	Sound	19	20
20	Household chemistry	20	19

the human body—moves into the major group in the later books. That forces one of the major topics of Overn's analysis —namely, combustion and fuel into the group of minor topics.

There is presented herewith a table showing the number of large topics and of sub-divisions treated by each of the twenty-five authors (Table II).

It is very evident from this tabulation that there are a great many major topics even that are not treated in the



Graph of Subject-matter in Twenty-five Texts.

general science texts by some of the authors and still more of the sub-divisions are omitted by many of the authors. Thus there are only 2 of the textbooks that treat all 20 of the major topics and one text book treats only 10 of them. The largest number of subdivisions treated by any one text book is 89 out of a total of 131 and the smallest number treated is 33. Furthermore, it will be noted by an examination of the page space devoted to these major topics and their subdivisions (see table III) that the space devoted to many of them is quite negligible. In other words, the treatment is incidental, the author merely mentioning the subject of the subdivision in connection with some topic that seems of larger importance to him.

One can not help concluding from an examination both of the summary table (II) and the detailed table (III) that there is no consensus of opinion as to what should be treated in a text in general science and that there has been no increase in the unanimity of opinion in this matter in the late books as compared with the earlier ones. One will see from the graph that 3 topics, mechanics, weather and climate and plants, are treated fairly extensively by nearly all the authors. Another group of 5 topics are treated moderately extensively and by a majority of the authors, but there is a great difference of opinion as to the value of the other 11 topics. Only one major topic is treated by all 25 authors. Ten additional ones are treated by 20 or more of the authors. Six more are treated by 60% of the authors and the remainder by less than 60 per cent; rocks and topography received consideration from only 11 authors. Glancing at the summary of the subdivisions of the major topics treated by the various authors, it will be noted that it is the rare exception for an author to treat all the subdivisions. If one adds together the maximum number of pages devoted to the treatment of the 131 subdivisions by any author, it gives a total of 2359.55 pages. In other words, if you should put into a single text the maximum space devoted by any author to all of the 131 subdivisions, you would have an encyclopedia of science rather than a textbook.

In this connection there will be reported in a brief abstract also another study dealing with general science texts (Mrs. Ailsie Heinemann, "An Analysis of General Science Texts in Terms of Principles and Their Application to Problems).

TABLE II

General Science texts, showing large topics and sub-divisions treated under each by each book.

	Mechanics, 14 Div.	Heat, 10 Div.	Sound, 2 Div.	Light, 7 Div.	Elec. and Mag. 7 Div.	Combustion, Fuels, 4 Div.	House. Chem. 4 Div.	El. Comp. Mix. 7 Div.	Bact. & San. 5 Div.	Food & Nut. 7 Div.	Human Body, 6 Div.	Lower An. 7 Div.	Plants, 13 Div.	Life in general, 3 Div.	Air & Vent. 3 Div.	Weather & Climate, 11 Div.	Water, uses & sup. 6 Div.	Erosion & Soil, 4 Div.	Earth & Planet, 3 Div.	Rocks & Topog. 8 Div.	20 Large Topics	131 Subdivisions
1. (Ba)	5	5		3		3			4	3			1		2	10	5					10-41
2. (Be)	4	5	1	5	7			1	2	3			5	1	2	8	3	4	2			15-53
3. (Bo)	6	5		7	3	4			5	3	5		6	1	3	9	5	1	2			15-65
4. C & M)	7	5		4	4	3	1		2	4	3	3	7				4					12-47
5. (C & E)	3	5			3	1			4	3			6	1	1	9	4	2	3			13-45
6. (C & E)	7				7				5	1		1	7	2	3	11	6	4	3			12-57
7. (C)	6	9	1	6	4	4	3	2	2	6	3	4	2	1	2	8	4	2		3		19-72
8. (E)	8	9	1	4	4	3	2	2	4	3	1	4	7	2	2	4	3		3			18-66
9. (H)	3	6	1	7	3	1	3	3	3	5	3	5	3	1	2	7	2	3		1		19-62
10. (H)	9	8	2	7	7	3	1	3	2	4	4	3	10	2	3	10	6	1	3	1		20-89
11. (Ho) ...	5	6	2	5	7	4	1		3	5	1				1	6	4		3			14-53
12. (H&WC)	10	1	1	4	4			2	3	3	3	2	7	2	1	9	6	4	1	3		18-66
13. (H&WH)	3	6		7	6	1	2		4	5	6	1	7		2	1	2	1	1			16-55
14. (L)	8	9	1	3	6	3		4	3	4	1	6	7	3	2	10	4	3	3			18-80
15. (N)	4	5	2	6	2	2		4	1			4	6	2	1	4	1					14-44
16. (P)	4	2		6	4	1		5	3	2		1	3	2		6		3	3	6		15-51
17. (P & B)	12	5	1	5	7	3	2	3	4	6	6	1	3	1	3	8	2		3	1		19-76
18. (S & J)	11	5		3	1	1		3	4				7	1	1	7	5			1		13-50
19. (S)	7	5	1	5	7	1	1	2	3	4	3	2	5	2	2	10	6	4	3	6		20-79
20. (S)	6	7		6	7			3	5	4	4	5	7	1	2	10	6	4	3	5		17-85
21. (T & L)	1	5		5	5	3	2		4	4	1		1		2	6	4					13-44
22. (T)	3	2	1	3	4	1			3	5		2	5		1	2	2		3			14-37
23. (V & S)	10	4	1	7	4	3		1	5	6	2		6	2	2	7	5		3	1		17-70
24. (W & D)	7	6	2	7	6	4	1		3	2	5	4	7	2		9	4	3	3	3		18-78
25. (W)	2	5	2	5	6	2	1	4								4	1		1			11-33
Treated by authors ..	25	24	15	23	24	21	12	15	24	22	16	16	23	18	21	24	24	14	18	11		

Note.—1. (Ba), Barber; 2. (Be), Bedford; 3. (Bo), Bowden; 4. (C & M), Caldwell & Meier; 5. (C & E), Caldwell & Eikenberry '18; 6. (C & E), Caldwell & Eikenberry '25; 7.(C), Clark; 8. (E), Elhuff; 9. (H), Hessler '15; 10. (H), Hessler '25; 11. (Ho), Hodgdon; 12. (H & W C), Hunter & Whitman Com.; 13. (H & W H), Hunter & Whitman Home; 14. (L), Lake; 15. (N), Nichols; 16. (P), Pease; 17. (P & B), Pieper & Beauchamp; 18. (S & J), Smith & Jewett; 19. (S), Snyder '19; 20. (S), Snyder '25; 21. (T & L), Tower & Lunt; 22. (T), Trafton; 23. (V & S), Van Buskirk & Smith; 24. (W & D), Webb & Didcoct; 25. (W), Washburn.

TABLE III

Detailed analysis of twenty-five texts in General Science, showing the page space devoted to 20 large topics and 131 subdivisions of these. Maximum page space of each topic is shown in bold type.

The numbers at the heads of the columns refer to the following books:

1. Caldwell and Meier, Open Doors to Science, 1925
2. Hessler, The First Year of Science, 1925
3. Pieper and Beauchamp, Everyday Problems in Science, 1925
4. Snyder, General Science, 1925
5. Caldwell and Eikenberry, Elements of General Science, 1924
6. Nichols, Science for Boys and Girls, 1924
7. Washburne, Common Science, 1924
8. Webb and Didcoct, Early Steps in Science, 1924
9. Bowden, General Science, 1923
10. Hunter and Whitman, Civic Science in the Community, 1923
11. Tower and Lunt, The Science of Common Things, 1922
12. Bedford, General Science, 1921
13. Hunter and Whitman, Civic Science in the Home, 1921
14. Snyder, Everyday Science, 1919
15. Trafton, Science of Home and Community, 1919
16. Van Buskirk and Smith, The Science of Everyday Life, 1919
17. Caldwell and Eikenberry, Elements of General Science, 1918
18. Hodgdon, An Elementary General Science, 1918
19. Smith and Jewett, An Introduction to the Study of Science, 1918
20. Lake, General Science, 1917
21. Barber, Fuller, Pricer, Adams, First Course in General Science, 1916
22. Elhuff, General Science, 1916
23. Clark, An Introduction to Science, 1915
24. Hessler, The First Year of Science, 1915
25. Pease, A First Course in General Science, 1915

If general science undertakes to give to pupils an understanding of their environment to the end that they may better control it, it would seem that such an understanding must be imparted in terms of a mastery of principles. For it is only when one does understand the principle involved that he is in position to solve a problematic situation. In how far then may such mastery be expected from a study of general science? That will be determined in no small measure by the type of treatment in the general science text.

This study seeks to determine how far the general science texts emphasize principle. There is presented then an analysis of 20 general science texts giving the page space and the percentage of printed matter devoted to principles, the number of principles included in each book and the number of applications together with percents for the same (Table IV). The

Detailed analysis of twenty-five texts in General Science, showing

	Total pages, Overn, 12 books	Total pages, Iler, 13 books	Total pages, 25 books	No. of authors treating—Overn	No. of authors treating—Iler	Total no. of authors treating	Least and greatest page space	Open Doors to Science	First Year of Science	Everyday Problems in Science	Snyder, General Science
	A	B	C	D	E	F	G	1	2	3	4
I. Mechanics, with applications to transportation and industry	675.95	500.1	1176.05	12	13	25	7.9-148.05	19.3	42.9	94.0	35.2
A. Matter and force, mechanical terms and principles, efficiency	155.0	91.4	246.4	8	9	17	....	..	18.9	9.8	12.7
B. Mechanics of solids	200.85	205.6	406.45	11	12	23	....	9.7	11.8	22.0	15.8
1. The six simple machines	111.00	106.8	217.8	8	11	19	1.2-25.0	1.2	7.1	15.5	11.0
2. Some common applications on the farm and in the home	43.1	24.9	68.0	5	7	12	0.9-17.0	..	2.3	3.9	..
3. Applications to transportation:											
a. Wagon roads and railroads	16.4	32.8	49.2	2	3	5	0.3-16.1	5.7	..	..	..
b. Bridges	9.6	7.8	17.4	1	4	5	0.9- 9.6	2.	0.9	..	..
c. The automobile	20.75	33.9	54.65	2	9	11	0.8-17.75	0.8	1.5	2.6	4.8
C. Mechanics of fluids	320.1	203.1	523.2	12	11	23	....	9.6	12.2	62.2	6.7
1. Water power:											
a. The siphon and pumps	39.3	31.7	71.0	5	3	16	1.3- 14.3	4.5	2.1	5.5	1.9
b. Hydraulic presses, etc.	42.6	2.5	45.1	6	1	7	1.5- 12.4	..	..	2.5	..
c. Water motors	42.0	6.0	48.0	7	2	9	1.9- 17.0	..	..	4.0	..
d. Rowboats	16.1	5.1	21.2	1	2	3	1.0- 16.1	..	..	1.0	..
2. Steam and gas power:											
a. Windmills & sailboats	14.4	13.0	27.4	4	4	8	0.8- 9.3	..	7.1	2.3	..
b. Steam engines; locomotives and steamships	86.35	47.2	133.55	8	8	16	0.9- 35.05	1.6	0.9	10.4	3.7
c. Gas engines; airplanes	5.0	40.3	95.3	9	6	15	0.5- 20.0	..	2.1	8.1	1.1
d. Gas pumps (gas pressure, properties of gases)	11.9	..	11.9	2	..	2	2.9- 9.	..	..	..	..
3. Instruments of navigation	12.45	57.3	69.75	2	4	6	3.5- 28.4	3.5	..	26.4	..
II. Heat	401.15	345.1	746.25	12	12	24	9.2- 81.	36.7	18.3	23.0	64.4
A. Sources and control of heat	17.7	80.4	98.1	5	8	13	0.8- 29.1	18.1	4.5	9.4	29.1
B. Temperature & heat meas'ment	72.75	36.3	109.05	11	8	19	0.8- 14.1	..	4.3	2.7	7.4
C. Common phenomena due to heat:											
1. Expansion, contraction, chemical effects, etc.	18.1	27.8	45.9	4	5	9	1.0- 8.7	..	1.0	..	3.9
2. Distillation, evaporation	40.6	15.8	56.4	6	1	7	2.25-15.8	..	..	..	..
3. Fusion and dissolution	14.95	..	14.95	4	0	4	1.8- 5.1	..	..	..	..
D. Heat transfer and some applications:											
1. Radiation and conduction	53.3	54.2	107.5	9	11	20	0.5- 13.05	1.8	1.1	0.5	7.5
2. Refrigeration, cooking devices	55.8	15.0	70.8	8	6	14	1.0- 30.4	5.3	1.3	..	3.1
3. Convection, hot air heating	67.65	42.7	110.35	11	10	21	1.3- 10.95	2.9	2.4	6.4	7.0
4. Hot water, steam and electric heating	38.7	46.3	85.0	7	10	17	1.2- 15.7	8.6	2.2	4.9	6.4
E. Mechanical energy and heat	21.9	26.6	48.5	1	4	5	1.5- 15.0	..	1.5	..	..
III. Sound	73.8	55.8	129.6	8	7	15	2.3- 27.1	..	8.1	3.4	..
A. Sound and hearing	47.25	38.6	85.85	7	6	12	1.9- 11.8	..	5.2	..	..
B. Musical instruments, voice	26.55	17.2	43.75	2	5	7	2.0- 18.95	..	2.9	3.4	..
IV. Light	336.2	393.6	729.8	11	12	23	8.05-70.9	19.5	31.2	28.3	40.1
A. Artificial production of light:											
1. Candles, kerosene lamps	25.15	42.5	67.65	7	10	17	1.2- 11.4	5.2	1.5	2.8	3.8
2. Gas and electric lighting	61.0	75.1	136.1	9	10	19	0.3- 23.2	6.9	2.2	9.1	1.6
B. Light transmission:											
1. Direct and indirect lighting	55.85	56.1	111.95	8	12	20	0.8- 16.4	1.5	1.8	6.4	4.7
2. Refraction, reflection and lenses	38.6	67.3	100.9	7	9	16	2.4- 24.1	..	11.6	..	8.7
C. Photography, color, chemical action of light	61.5	60.4	121.9	8	7	15	1.0- 26.15	5.9	7.6	..	..
D. Other physical properties, theory and imp. of light	46.05	41.3	87.35	7	6	13	0.65-16.1	..	3.0	5.6	16.1
E. The human eye	53.05	50.9	103.95	8	10	18	0.8- 22.95	..	3.5	4.4	5.2

TABLE III

nce, showing the page space devoted to 20 large topics and 18

First Year of Science	Everyday Problems in Science	Snyder, General Science	Elements of General Science	Science for Boys and Girls	Common Science	Early Steps in Science	Bowden, General Science	Civic Science in Community	Science of Common Things	Bedford, General Science	Civic Science in Home	Everyday Science	Science of Home
2	3	4	5	6	7	8	9	10	11	12	13	14	15
42.9	94.0	35.2	41.2	17.5	37.4	70.0	41.2	59.2	7.9	18.6	15.7	29.8	64.25
18.9	9.8	12.7	11.6	1.3	27.9	..	4.1	2.6	..	2.5	..	..	..
11.8	22.0	15.8	14.0	14.9	9.5	38.1	24.0	10.5	..	16.1	11.2	11.45	17.75
7.1	15.5	11.0	4.2	8.1	9.5	11.6	22.7	..	..	8.2	7.7	7.45	..
2.3	3.9	..	0.9	6.8	..	2.8	..	..	..	4.7	3.5	4.0	..
..	..	..	..	..	..	12.0	..	14.5	..	..	..	..	..
0.9	..	..	..	..	..	3.6	..	1.2	..	..	..	..	..
1.5	2.6	4.8	8.9	..	..	8.1	1.3	2.7	..	3.2	..	..	17.75
12.2	62.2	6.7	15.6	1.3	..	31.9	13.1	38.1	7.9	..	4.5	10.35	46.5
2.1	5.5	1.9	4.0	1.3	..	..	..	..	7.9	..	4.5	..	..
..	2.5	..	..	..	..	..	..	..	..	..	..	6.15	..
..	4.0	..	..	..	..	..	..	2.0	..	..	..	2.7	..
..	1.0	..	..	..	..	..	..	4.1	..	..	..	..	..
7.1	2.3	..	..	..	..	..	2.6	1.0	..	..	..	..	..
0.9	10.4	3.7	4.1	..	..	..	6.0	9.3	..	..	..	1.0	28.9
2.1	8.1	1.1	7.5	..	..	..	4.5	17.0	..	..	..	0.5	17.6
..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	28.4	..	..	..	..	..	..	4.7	..	..	..	..	..
18.3	23.0	64.4	..	12.5	48.6	25.2	38.4	1.0	29.5	12.2	35.3	28.95	9.2
4.5	9.4	29.1	..	..	..	..	..	1.0	5.6	5.0	7.7	..	..
4.3	2.7	7.4	..	0.8	..	..	8.0	..	4.1	..	2.1	6.5	..
1.0	..	3.9	..	..	8.7	6.5	7.7	..	..	..	..	..	..
..	..	..	..	..	15.8	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..
1.1	0.5	7.5	..	5.1	11.4	3.8	12.4	..	7.3	2.2	1.1	4.9	..
1.3	..	3.1	..	1.9	..	1.4	..	..	..	2.0	..	2.85	..
2.4	6.4	7.0	..	2.8	2.6	3.4	3.9	..	4.3	1.3	5.7	4.1	4.8
2.2	4.0	6.4	..	1.9	..	3.2	6.4	..	8.2	1.7	3.7	..	4.4
1.5	..	..	..	..	10.1	..	..	..	..	..	15.0	10.6	..
8.1	3.4	..	..	9.7	15.2	8.9	..	1.9	..	8.6	..	2.2	7.6
5.2	..	..	..	7.7	11.8	3.4	..	1.9	..	8.6	..	2.3	..
2.9	3.4	..	..	2.0	3.4	5.5	..	..	..	..	..	..	7.6
31.2	28.3	40.1	..	14.2	51.0	34.9	70.9	13.0	34.5	25.1	30.9	22.2	37.6
1.5	2.8	3.3	..	2.0	..	2.8	11.4	1.2	10.4	..	1.4	..	5.55
2.2	9.1	1.6	..	2.0	..	4.3	14.8	9.4	20.1	..	4.2	0.9	5.9
1.8	6.4	4.7	..	2.5	3.5	2.7	15.6	1.7	0.8	11.2	3.7	..	..
11.6	..	3.7	..	3.7	24.1	1.7	9.1	..	2.4	2.7	3.3	3.15	..
7.6	..	..	..	..	17.5	12.7	4.8	..	..	2.5	9.4	4.35	26.15
3.0	5.6	16.1	..	3.0	3.0	1.7	4.2	0.7	0.8	2.6	0.7	10.6	..
3.5	4.4	5.2	..	1.0	2.9	8.5	11.0	..	..	6.2	8.2	2.7	..

opics and 131 subdivisions of these

Civic Science in Home	Everyday Science	Science of Home	Science of Everyday Life	Elements of Gen. Science	Elementary Gen. Science	Introduction to Science	Lake, General Science	First Course in Gen. Science	Elhuff, General Science	Introduction to Science	First Year of Science	First Course in Gen. Science
13	14	15	16	17	18	19	20	21	22	23	24	25
5.7	29.8	64.25	51.15	22.4	30.7	148.05	60.85	67.0	61.5	43.8	52.7	43.75
..	..	..	14.05	..	11.0	..	29.1	25.5	6.2	..	36.7	29.45
1.2	11.45	17.75	23.05	10.0	13.0	36.4	12.2	17.0	25.0	21.0	14.0	..
7.7	7.45	..	15.15	10.0	6.2	..	12.2	..	25.0	21.0	14.0	..
3.5	4.0	..	4.6	..	6.8	10.7	..	17.0	..	..	..	..
..	..	..	0.3	..	..	16.1	..	..	..	..	..	..
..	..	..	..	..	..	9.6	..	..	..	..	..	..
..	..	17.75	3.0	..	..	..	..	..	..	..	..	..
4.5	10.35	46.5	14.05	12.4	6.7	111.65	19.55	24.5	30.3	22.8	2.0	19.3
4.5	..	..	..	4.2	3.0	1.3	2.5	..	8.0	14.3	2.0	4.0
..	6.15	..	4.6	8.2	..	1.5	9.75	..	..	..	..	12.4
..	2.7	..	2.0	..	..	17.0	3.8	8.9	5.7	1.9	..	..
..	..	..	..	..	..	16.1	..	..	..	..	..	..
..	..	..	..	..	..	9.3	0.8	..	1.6	2.7	..	..
..	1.0	28.9	4.6	..	..	35.03	1.7	8.5	3.8	2.8	..	..
..	0.5	17.6	1.8	..	3.7	20.0	1.0	7.1	2.2	1.1	..	..
..	..	..	..	..	..	..	..	..	9.0	..	..	..
..	..	..	1.05	..	..	11.4	..	..	..	..	..	..
5.3	23.95	9.2	15.25	32.3	48.0	56.75	23.7	81.0	42.8	31.2	22.0	10.0
7.7	..	..	..	..	..	11.7	2.05	..	1.05	0.8	2.1	..
2.1	6.5	..	2.85	..	11.0	14.1	4.4	6.6	7.8	5.6	6.4	5.0
..	..	..	..	..	7.25	..	2.95	..	3.5	4.4	..	..
..	..	..	..	10.7	..	..	2.2	10.8	8.0	5.3	3.6	..
..	..	..	..	..	4.75	..	1.8	..	3.0	5.1	..	..
1.1	4.9	..	4.5	..	13.05	12.45	5.5	..	3.7	1.6	2.6	5.0
..	2.85	..	..	4.1	1.0	11.0	1.2	30.4	3.05	2.2	..	..
5.7	4.1	4.8	3.4	3.7	10.95	7.5	2.4	17.5	5.5	2.9	4.9	..
3.7	..	4.4	4.5	..	..	..	1.2	15.7	7.2	3.3	2.4	..
5.0	10.6	..	..	11.3	..	..	..	..	..	..	..	..
..	2.3	7.6	3.15	..	27.1	..	7.25	..	10.7	7.3	8.4	..
..	2.3	..	3.15	..	8.15	..	7.25	..	10.7	7.3	8.4	..
..	..	7.6	..	..	18.95	..	..	..	..	..	..	..
0.9	22.2	37.6	22.5	..	63.0	27.7	25.25	35.6	20.8	39.8	33.7	..
1.4	..	5.55	2.7	..	..	2.4	..	7.8	2.3	2.6	1.8	..
4.2	0.9	5.9	7.5	..	..	23.2	..	11.4	2.5	2.8	6.5	0.3
3.7	..	..	4.1	..	13.6	..	5.25	16.4	1.0	11.7	1.8	2.0
3.3	3.15	..	4.1	..	8.35	..	..	..	5.4	6.4	3.7	2.5
0.4	4.85	26.15	1.2	..	9.7	2.1	..	..	..	12.7	3.8	1.0
0.7	10.6	..	2.1	..	8.4	..	15.2	..	..	..	9.1	0.65
8.2	2.7	..	0.8	..	22.95	..	4.8	..	9.6	3.6	7.0	1.6

	Total pages, Overn, 12 books	Total pages, Iler, 13 books	Total pages, 25 books	No. of authors treating—Overn	No. of authors treating—Iler
	A	B	C	D	E
V. Electricity and magnetism	309.45	464.2	773.65	11	13
A. Static electricity	28.5	18.3	46.8	6	8
B. Magnets and electromagnets	54.9	69.1	124.6	9	11
C. Electric bell, telephone, telegraph	65.8	153.1	218.9	7	12
D. The dynamo	14.25	24.0	38.25	5	8
E. Electric currents	89.75	105.6	195.35	9	11
F. Motors and electric industries	50.7	38.6	89.3	10	11
G. Theory and measurement of electricity	5.5	54.9	60.4	2	11
VI. Combustion and fuels	235.35	176.3	411.65	12	9
A. The chemistry of combustion	134.0	79.0	213.0	12	8
B. Wood and coal as fuels	33.7	26.8	60.5	5	6
C. Liquid and gas fuels	54.05	43.2	97.25	5	6
D. Value of oxidation (carbon cycle)	13.6	27.3	40.9	4	5
VII. Household Chemistry	50.85	61.0	111.85	5	7
A. Chemistry of cleaning	20.95	15.3	36.25	5	3
B. Bleaching, blueing, starching, dyeing	15.3	34.4	49.7	2	3
C. Oils, paints, varnishes, removal of stains	6.6	10.2	16.8	2	4
D. Chemistry of baking	8.0	1.1	9.1	1	1
VIII. Elements, compounds, mixtures	160.35	130.2	290.55	8	7
A. Chemical changes, atoms and molecules	41.15	53.2	94.35	5	4
B. Acids, bases and salts	30.4	27.3	57.7	6	4
C. The chief metals, other common elements:					
1. Iron ore and its reduction	12.85	6.3	19.15	1	4
2. Steel and wrought iron	11.35	3.9	15.25	1	2
3. Other elements	19.2	16.6	35.8	2	2
D. Compounds of carbon:					
1. Limestone and other carbonates	19.0	21.0	40.0	3	3
2. Manufactured mineral products	26.4	1.9	28.3	4	1
IX. Bacteriology and Sanitation	432.95	323.2	756.15	12	12
A. Saprophytes:					
1. Molds and yeasts	52.75	29.5	82.25	8	5
2. Useful bacteria	49.55	16.1	65.65	7	7
B. Parasites and germ diseases	163.8	53.2	217.0	11	7
C. Public health and sanitation	97.2	137.2	234.4	8	10
D. Insects as disease carriers	69.65	87.2	156.85	7	11
X. Food and nutrition	448.35	290.5	738.85	11	11
A. Selection of Food:					
1. Composition and cost	143.65	88.5	232.15	10	8
2. Manufacture of food products	36.3	7.7	44.0	3	2
3. Alcohol, drugs, patent medicines	41.3	36.4	77.7	7	5
B. Preparation (cooking) of foods	59.8	20.0	79.8	7	4
C. Preservation, adulteration of foods	67.15	55.2	112.35	7	6
D. Nutrition:					
1. Digestion	40.95	50.9	91.85	6	8
2. Hygiene of nutrition	59.2	34.8	94.0	6	6
XI. The human body	154.75	405.7	560.45	7	9
A. Structure, nervous system, special senses	29.9	93.2	123.1	2	6
B. Functions, circulation, respiration, perspiration	52.4	74.6	127.0	5	6

TABLE III—*Continued*

Total pages, 25 books	No. of authors treating—Overn	No. of authors treating—Iler	Total no. of authors treating	Least and greatest page space	Open Doors to Science	First Year of Science	Everyday Problems in Science	Snyder, General Science	Elements of General Science	Science for Boys and Girls	Common Science	Early Steps in Science	Bowden, General Science
C	D	E	F	G	1	2	3	4	5	6	7	8	9
773.65	11	13	24	5.7- 71.6	13.6	59.9	53.5	32.7	53.8	5.7	71.6	40.7	22.8
46.8	6	8	14	0.5- 8.4	..	2.1	0.5	3.2	1.1	2.2	6.3	..	..
124.6	9	11	20	1.5-14.7	..	10.9	2.0	5.0	6.8	3.5	7.8	5.1	10.6
218.9	7	12	19	2.0-29.55	9.6	24.0	25.6	8.4	16.5	..	6.5	23.9	8.0
38.25	5	8	13	1.25-5.4	..	2.8	2.5	1.5	2.8	..	5.2	3.0	4.2
195.35	9	11	20	1.0-39.3	2.0	11.1	16.9	5.6	9.9	..	39.3	2.2	..
89.3	10	11	21	0.5-13.2	1.0	3.8	3.7	1.1	6.6	..	..	5.5	..
60.4	2	11	13	0.8-17.1	1.0	5.2	2.3	7.9	8.1	..	6.5	1.0	..
411.65	12	9	21	1.0-58.0	13.8	11.9	22.9	..	..	10.3	13.3	18.7	43.2
213.0	12	8	20	1.0-42.55	5.8	9.4	11.3	..	..	..	12.3	8.8	14.6
60.5	5	6	11	1.0-13.8	1.0	..	3.6	..	..	3.6	..	2.4	6.4
97.25	5	6	11	0.3-25.8	7.0	0.3	8.0	..	..	..	..	5.5	6.3
40.9	4	5	9	0.6-15.4	..	2.2	..	..	..	6.7	1.0	2.0	15.4
111.85	5	7	12	1.0-31.2	1.7	6.5	6.9	..	..	..	1.1	31.2	..
36.25	5	3	8	1.0- 6.5	..	6.5	4.6	..	..	..	..	..	..
49.7	2	3	5	0.5-31.2	..	..	..	..	..	..	..	31.2	..
16.8	2	4	6	1.7- 4.0	1.7	..	2.3	..	..	..	..	..	..
9.1	1	1	2	1.1- 8.6	..	..	..	..	..	..	1.1	..	..
290.55	8	7	15	0.3-68.0	..	15.0	7.6	18.0	..	9.8	68.0	..	..
94.35	5	4	9	2.2-37.1	..	2.2	..	11.5	..	2.4	37.1	..	..
57.7	6	4	10	2.3-15.6	..	5.8	..	3.2	..	2.7	15.6	..	..
19.15	1	4	5	0.1-12.85	..	..	3.2	..	..	1.0	2.0	..	..
15.25	1	2	3	0.2-11.35	..	..	..	..	..	3.7	..	..	..
35.8	2	2	4	3.3-13.3	..	..	..	3.3	..	..	13.3	..	..
40.0	3	3	6	1.1-14.8	..	7.0	2.5	..	..	..	..	..	..
28.3	4	1	5	1.9-11.5	..	..	1.9	..	..	..	..	..	..
756.15	12	12	24	2.3-83.7	21.7	2.3	32.8	20.2	23.7	8.8	..	33.6	41.6
82.25	8	5	13	0.7-20.7	..	..	..	2.4	1.4	..	..	..	3.1
65.65	7	7	14	0.5-19.6	..	..	2.3	1.7	1.0	..	..	0.9	2.1
217.0	11	7	18	1.25-29.55	..	..	6.5	3.7	5.9	..	..	..	7.3
234.4	8	10	18	0.4-31.2	9.1	0.4	16.4	10.2	3.2	..	..	25.5	16.6
156.85	7	11	18	.07-23.0	12.6	1.9	7.6	2.2	7.2	3.8	..	7.2	7.5
738.85	11	11	22	7.6-89.25	41.9	20.2	33.4	17.1	7.6	..	..	19.0	43.1
232.15	10	8	18	3.4-20.5	7.5	4.8	3.4	3.3	..	..	..	..	15.2
44.0	3	2	5	0.5-19.5	7.2	..	..	..	..	..	..	..	..
77.7	7	5	12	1.1-27.0	..	1.7	3.2	1.1	..	..	..	..	27.0
79.8	7	4	11	0.7-19.9	9.3	..	4.6	0.7	..	..	..	..	..
112.35	7	6	13	0.3-20.0	17.9	..	7.5	..	..	..	..	..	..
91.85	6	8	14	1.0-15.7	..	5.7	7.8	7.0	..	..	..	13.5	5.9
94.0	6	6	12	2.5-26.3	..	8.0	6.9	..	7.6	..	..	5.5	..
560.45	7	9	16	2.2-79.0	54.1	67.8	33.4	46.6	..	..	..	45.2	63.1
123.1	2	6	8	0.8-31.2	..	26.7	4.3	3.9	..	..	..	23.9	31.2
127.0	5	6	11	1.6-22.9	..	22.8	7.1	9.8	..	..	..	10.1	16.7

ontinued

Common Science	Early Steps in Science	Bowden, General Science	Civic Science in Community	Science of Common Things	Bedford, General Science	Civic Science in Home	Everyday Science	Science of Home	Science of Everyday Life	Elements of Gen. Science	Elementary Gen. Science	Introduction to Science	Lake, General Science	First Course in Gen. Science	Elhuff, General Science	Introduction to Science	First Year of Science	First Course in Gen. Science
7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
71.6	40.7	22.8	18.1	44.8	22.0	25.0	26.1	48.0	16.65	47.3	32.4	13.2	26.8	..	34.6	30.55	24.4	9.45
6.3	..	..	..	..	0.9	2.0	4.2	..	..	..	3.5	..	8.4	..	2.6	..	6.0	3.8
7.8	5.1	10.6	..	9.1	2.3	6.6	6.9	1.6	5.35	10.0	1.9	..	7.9	..	14.7	..	5.1	1.5
6.5	23.9	8.0	11.6	9.0	3.7	4.3	5.6	29.55	6.45	..	7.4	..	2.0	..	7.3	7.5	..	..
5.2	3.0	4.2	..	..	2.0	..	1.7	..	1.25	..	3.5	..	2.4	..	..	5.4	..	..
39.3	2.2	..	1.0	6.6	2.2	8.8	5.4	6.8	..	29.0	7.75	..	5.6	..	10.0	9.3	13.3	2.6
..	5.5	..	2.7	3.0	9.1	2.1	1.5	10.05	3.6	8.3	3.65	13.2	0.5	..	..	8.35	..	1.55
6.5	1.0	..	2.8	17.1	1.8	1.2	0.8	..	..	..	4.7	..	..	..	..	..	..	..
13.3	18.7	43.2	..	41.2	..	1.0	11.0	4.4	15.2	9.4	38.1	42.55	11.3	58.0	14.05	25.0	1.8	4.55
12.3	8.8	14.6	..	15.8	..	1.0	11.0	4.4	11.7	9.4	6.8	42.55	4.0	18.4	6.0	13.4	1.8	4.55
..	2.4	6.4	..	9.8	..	..	..	..	2.3	..	6.8	..	4.9	13.8	..	5.9	..	..
..	5.5	6.8	..	15.6	..	..	..	..	..	..	18.7	..	2.4	25.8	2.05	5.1	..	..
1.0	2.0	15.4	..	..	..	..	..	..	1.2	..	5.8	..	..	..	6.0	0.6	..	..
1.1	31.2	..	..	10.6	..	3.0	1.0	..	..	..	4.75	..	..	..	12.3	23.4	9.4	..
..	..	..	..	4.2	..	..	..	..	..	..	..	..	..	..	4.3	4.9	6.0	..
..	31.2	..	..	2.7	..	0.5	..	..	..	..	..	..	..	..	..	14.5	0.8	..
..	..	..	..	3.7	..	2.5	..	..	..	..	..	..	..	..	..	4.0	2.6	..
1.1	..	..	..	..	..	..	8.6	..	7.0	..	..	..	..	..	8.0	..	..	..
68.0	..	..	0.3	..	11.5	..	5.0	..	..	..	..	35.7	23.85	..	9.1	14.1	39.4	22.6
37.1	..	..	..	..	..	..	3.6	..	..	..	..	..	13.25	..	3.7	..	15.5	3.7
15.6	..	..	..	..	..	..	..	..	..	..	..	..	4.9	..	5.4	5.1	9.1	2.3
2.0	..	..	0.1	..	..	..	..	..	..	..	..	12.85	..	..	..	..	..	..
..	..	..	0.2	..	..	..	..	..	..	..	..	11.35	..	..	..	..	..	..
13.3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	9.0	..	10.2
..	..	..	..	..	11.5	..	..	..	..	1.1	..	..	3.1	..	..	..	14.8	1.1
..	..	..	..	..	..	..	..	..	7.0	5.3	..	11.5	2.6	..	..	..	..	5.3
..	33.6	41.6	58.3	33.6	20.4	26.2	16.1	77.9	29.5	26.5	35.0	83.7	32.9	64.2	18.05	10.55	27.4	11.15
..	..	8.1	..	13.6	..	4.0	5.2	..	6.2	2.5	..	20.7	1.7	14.5	1.25	..	..	0.7
..	0.9	2.1	..	3.8	4.3	..	..	..	0.7	7.7	2.45	18.0	0.6	19.6	0.5	..	..	..
..	..	7.3	8.0	15.5	..	6.3	7.7	28.6	8.2	8.3	29.55	22.0	..	25.3	9.0	6.05	17.85	1.25
..	25.5	16.6	31.2	..	16.1	3.5	..	26.6	10.85	..	3.0	..	30.6	4.8	..	4.5	7.65	9.2
..	7.2	7.5	19.1	0.7	..	12.4	3.2	22.7	3.55	8.0	..	23.0	..	..	7.3	..	1.9	..
..	19.0	48.1	12.1	29.1	31.5	30.5	16.0	89.25	40.9	26.1	70.00	..	26.5	41.9	28.0	63.25	30.2	16.25
..	..	15.2	..	20.5	14.8	11.0	9.2	13.7	19.65	..	32.3	..	12.1	17.3	9.9	15.0	3.5	11.0
..	..	..	0.5	..	..	..	..	..	..	..	..	..	9.1	19.5	..	7.7	..	..
..	..	27.0	3.4	..	..	..	..	17.4	1.2	3.5	..	..	2.5	..	6.7	5.0	5.0	..
..	..	..	..	..	..	5.4	1.7	19.9	4.55	..	8.2	..	2.8	..	..	17.4	..	5.25
..	..	..	8.2	0.3	14.7	6.6	2.0	11.95	9.5	..	20.0	..	..	5.1	..	12.6	6.0	..
..	13.5	5.9	..	4.0	2.0	5.0	3.1	..	3.2	15.7	1.0	..	..	..	..	5.55	12.4	..
..	5.5	..	..	4.3	..	2.5	..	26.3	2.8	6.9	8.5	..	..	..	11.4	..	3.3	..
..	45.2	63.1	2.2	14.3	..	79.0	9.75	..	48.7	..	24.2	..	3.6	..	3.2	11.3	54.0	..
..	23.9	31.2	..	..	..	3.2	0.8	..	..	..	..	..	..	..	..	..	29.1	..
..	10.1	16.7	..	..	..	8.1	6.4	..	17.9	..	..	..	3.6	..	..	1.6	22.9	..

	Total pages, Overn, 12 books	Total pages, Iler, 13 books	Total pages, 25 books	No. of authors treating—Overn	No. of authors treating—Iler	Total no. of authors treating	Least and greatest page space	Open Doors to Science	First Year of Science	Everyday Problems in Science	Snyder, General Science
	A	B	C	D	E	F	G	1	2	3	4
C. Care:											
1. First aid	30.65	13.2	43.85	5	6	11	0.7-24.2	..	1.1	3.3	..
2. Clothing and protection	31.8	79.5	111.3	2	8	10	0.1-25.8	25.8	..	12.8	4.6
3. Homes, house building	10.0	86.1	96.1	1	6	7	1.1-36.8	13.5	..	4.0	28.3
4. Maintenance of health	..	59.1	59.1	0	5	5	1.9-17.2	14.8	17.2	1.9	..
XII. Lower animals	150.25	133.7	283.95	7	9	16	1.6-44.5	26.2	11.0	1.9	21.5
A. Classification of lower animals:											
1. Invertebrates	52.55	61.6	114.15	6	5	11	1.7-22.2	15.5	..	..	10.9
2. Vertebrates:											
a. Fish, amphibia, reptiles	14.15	4.6	18.75	4	4	8	0.1- 5.0	..	0.1	..	2.5
b. Birds, their use to man	43.95	30.0	73.95	5	5	10	0.3-39.3	8.3	3.0	..	3.7
c. Mammals, domestic	12.95	2.1	15.05	5	2	7	0.55-5.5	..	..	..	1.2
B. Animal physiology	14.1	14.9	29.0	1	3	4	1.9-14.1	..	..	..	..
C. Animals in relation to man:											
1. Uses of animals	5.3	13.3	18.6	2	3	5	1.9- 7.9	..	7.9	1.9	..
2. Animal pests	7.25	7.2	14.45	1	2	3	1.6- 7.25	2.4	..	..	3.2
XIII. Plants	455.6	496.4	952.0	11	12	22	5.0-87.9	16.2	36.1	14.3	64.5
A. Distribution and root structure	38.1	50.2	88.3	6	9	15	0.6-16.6	0.6	0.7	..	1.3
B. Plant growth, leaves, stem	87.25	110.9	198.15	7	10	17	0.7-24.9	..	6.5	3.2	15.1
C. Plant diseases, pests; struggle for existence	29.0	45.5	74.5	4	6	10	3.8-13.3	3.8	3.8	..	7.5
D. Plant breeding, Mendel's Law	35.4	93.3	128.7	3	8	11	1.0-25.4	..	8.4	..	20.5
E. Soil in relation to plants:											
1. Soil composition	56.8	62.4	119.3	9	9	18	0.3-16.0	..	2.1	..	14.5
2. Care, cultivation of soil	44.85	18.9	63.75	5	6	11	0.1-13.6	0.1	2.5	..	1.7
3. Forestry and soil conservation	36.15	37.4	73.55	3	6	9	3.8-24.45	..	3.8	5.9	3.9
F. Horticulture:											
1. House plants	10.	2.7	12.7	1	2	3	1.1-10.0	1.6	..	..	..
2. Gardening:											
a. Landscape, home grounds	19.	43.1	62.1	1	4	5	1.2-28.7	7.6	1.2	..	..
b. Vegetable	25.5	7.2	32.7	2	2	4	2.0-22.6	2.0	..	..	..
c. Fruit	11.	4.4	15.4	1	4	5	0.5-11.0	0.5	1.0	..	..
G. Commercial plant products:											
1. Food for men and animals	37.3	7.0	44.3	5	3	8	0.9-15.0	..	4.5	..	..
2. Other products	25.15	13.4	38.55	5	5	10	0.6- 6.4	..	0.6	5.2	..
XIV. Life in general	165.85	119.5	285.35	9	9	18	2.2-45.8	..	2.2	3.0	2.2
A. Living matter, structure, properties	13.25	9.4	22.65	2	4	6	1.5-11.0	..	1.5	..	2.2
B. Reproduction in plants and animals	101.2	73.6	174.8	9	5	14	4.0-25.1	..	..	..	..
C. Adaptability of life to physical conditions	51.4	36.5	87.9	4	5	9	0.7-32.3	..	0.7	3.0	..
XV. Air and ventilation	118.15	151.4	269.55	11	10	21	0.3-33.8	..	17.6	15.5	5.0
A. Composition, properties (dust and its dangers)	46.05	72.8	118.85	9	8	17	0.3-20.6	..	10.6	2.0	3.0
B. Principles and systems of ventilation	72.1	41.8	123.9	9	7	16	1.7-25.9	..	3.1	4.3	..
C. Uses of air to modern industry	..	36.8	36.8	0	7	7	1.2-10.8	..	3.9	9.2	2.0
XVI. Weather and climate	594.0	465.3	1059.3	12	12	24	0.8-134.7	..	36.2	44.4	63.4
A. Weather:											
1. Weather maps, forecasts, observations	87.65	52.9	140.55	12	9	21	0.9-15.9	..	5.0	12.4	9.5
2. Air pressure, barometer, compressed and liquid air	128.7	107.5	236.2	12	12	24	0.8-23.9	..	6.1	9.5	13.7
3. Humidity or water vapor in air:											
a. Moisture and evaporation	59.6	58.9	118.5	8	11	19	1.2-19.4	..	3.1	1.2	11.0
b. Condensation and clouds	36.9	47.7	84.6	9	11	20	0.9-12.8	..	3.2	5.2	2.2
c. Precipitation, atmospheric heating and frosts	58.8	15.6	74.4	8	6	14	0.5-19.1	..	1.7	..	1.8

TABLE III—*Continued*

First Year of Science	Everyday Problems in Science	Snyder, General Science	Elements of General Science	Science for Boys and Girls	Common Science	Early Steps in Science	Bowden, General Science	Civic Science in Community	Science of Common Things	Bedford, General Science	Civic Science in Home	Everyday Science	Science of Home	
2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1.1	3.3	..	..	..	..	2.5	2.8	1.0	..	..	2.5	2.55	..	
..	12.8	4.6	..	..	..	6.3	2.2	0.1	14.3	..	13.4	..	..	2
..	4.0	28.3	..	..	..	2.4	..	1.1	..	..	36.8	..	..	1
17.2	1.9	..	..	..	..	..	10.2	..	..	..	15.0	..	..	
11.0	1.9	21.5	13.0	39.5	..	13.8	..	5.2	..	..	1.6	10.85	44.5	
..	..	10.9	..	22.2	..	11.3	..	1.7	..	..	..	5.8	5.2	
0.1	..	2.5	..	1.2	..	0.8	..	..	..	..	..	..	..	
3.0	..	3.7	..	14.2	..	0.8	..	..	..	..	..	..	39.3	
..	..	1.2	..	..	..	0.9	..	..	..	..	..	2.05	..	
..	..	..	13.0	1.9	..	..	..	3.6	..	..	..	..	..	
7.9	1.9	..	..	..	..	..	..	..	..	..	..	..	..	
..	..	3.2	..	..	..	..	..	..	..	..	1.6	..	..	
36.1	14.3	64.5	40.9	73.3	..	52.3	37.9	30.4	6.0	37.4	37.2	50.85	87.05	3
0.7	..	1.3	9.3	6.3	..	5.9	16.6	3.1	..	6.4	..	8.0	..	
6.5	3.2	15.1	12.7	16.9	..	18.6	24.9	3.2	6.0	3.8	..	13.5	..	
3.8	..	7.5	..	7.6	..	..	..	..	..	9.5	13.3	..	..	
8.4	..	20.5	1.0	12.7	..	4.3	25.4	9.2	..	11.9	..	..	..	
3.1	..	14.5	9.5	1.1	..	3.3	14.0	1.7	..	5.8	9.5	9.6	..	
2.5	..	1.7	..	..	..	9.6	3.0	..	..	..	2.0	13.35	..	
3.8	5.9	3.9	5.2	..	..	8.3	..	10.3	..	..	..	6.4	24.45	
..	..	..	..	..	..	..	..	..	..	..	1.1	..	10.0	
1.2	..	..	..	28.7	..	..	..	..	..	..	5.6	..	19.0	
..	..	..	..	..	..	..	..	..	..	..	5.2	..	22.6	
1.0	..	..	..	..	..	2.4	..	..	..	..	0.5	..	11.0	
4.5	..	..	1.6	..	..	..	..	0.9	..	..	..	..	..	1
0.6	5.2	..	1.6	..	..	..	4.0	2.0	..	..	..	..	..	
2.2	3.0	2.2	34.8	13.7	..	28.7	3.8	25.6	..	5.5	..	45.8	..	1
1.5	..	2.2	..	1.9	..	..	3.8	..	..	..	..	..	..	
..	..	..	25.1	11.8	..	20.1	..	11.1	..	5.5	..	13.5	..	
0.7	3.0	..	9.7	..	..	8.6	..	14.5	..	..	..	32.3	..	
17.6	15.5	5.0	33.8	1.2	..	..	32.8	0.3	19.6	16.4	9.2	6.8	15.3	
10.6	2.0	3.0	20.6	..	..	..	13.3	0.3	15.9	..	7.1	4.4	..	
3.1	4.3	..	6.8	..	..	..	16.2	..	5.7	5.6	2.1	2.4	15.3	
3.9	9.2	2.0	6.4	1.2	..	..	3.3	..	..	10.8	..	..	..	
36.2	44.4	63.4	71.4	6.8	35.8	42.6	53.7	35.7	30.8	43.7	0.8	71.3	11.9	3
5.0	12.4	9.5	7.1	..	..	0.9	7.8	2.7	4.5	3.0	..	2.55	5.2	
6.1	9.5	13.7	11.8	2.6	23.9	3.7	12.3	9.0	4.8	9.3	0.8	19.4	2.7	1
3.1	1.2	11.0	5.4	1.8	4.3	1.4	12.5	4.9	7.8	5.5	..	7.4	..	
3.2	5.2	2.2	5.0	1.5	1.0	10.8	6.5	1.7	4.8	5.8	..	1.3	..	
1.7	..	1.8	0.5	..	6.6	..	1.2	..	..	3.8	..	9.4	..	

	Everyday Science	Science of Home	Science of Everyday Life	Elements of Gen. Science	Elementary Gen. Science	Introduction to Science	Lake, General Science	First Course in Gen. Science	Elhuff, General Science	Introduction to Science	First Year of Science	First Course in Gen. Science
	14	15	16	17	18	19	20	21	22	23	24	25
5	2.55	..	..	..	24.2	..	..	..	3.2	0.7	..	..
4	..	..	20.8	..	..	..	..	..	..	9.0	..	..
3	..	..	10.0	..	..	..	..	..	..	..	..	..
0	..	..	..	..	..	..	..	..	..	..	..	..
6	10.85	44.5	..	..	..	..	21.2	..	14.5	19.3	25.8	14.1
.	8.8	5.2	..	..	..	..	8.8	..	8.1	8.15	13.5	..
.	..	..	..	..	..	..	1.8	..	2.55	4.8	5.0	..
.	..	39.3	..	..	..	..	0.3	..	2.1	0.85	1.4	..
.	2.05	..	..	..	..	..	0.55	..	1.75	5.5	3.1	..
.	..	..	..	..	..	..	..	..	..	..	..	14.1
.	..	..	..	..	..	..	2.5	..	..	..	2.8	..
6	..	..	..	..	..	..	7.25	..	..	..	..	..
2	50.85	87.05	31.55	58.45	..	48.0	39.45	5.0	63.25	26.8	22.9	22.2
.	8.0	..	..	12.8	..	1.5	2.3	..	2.7	..	10.8	..
.	13.5	..	0.7	7.2	..	..	10.35	..	17.0	21.9	..	16.6
.3	..	..	..	3.8	..	5.6	7.4	..	7.2	..	..	..
.	..	..	4.0	12.6	..	18.8	..	..	..	..	..	..
.5	9.6	..	2.65	5.85	..	8.0	4.8	5.0	16.0	..	4.6	0.3
.0	13.35	..	..	..	..	3.2	7.2	..	13.6	..	7.5	..
.	6.4	24.45	..	..	..	..	..	..	..	..	..	5.3
.1	..	10.0	..	..	..	..	..	..	..	..	..	..
.6	..	19.0	..	..	..	..	..	..	..	..	..	..
.2	..	22.6	2.9	..	..	..	..	..	..	..	..	..
.5	..	11.0	..	..	..	..	..	..	..	..	..	..
.	..	..	15.0	11.2	..	7.6	1.0	..	2.5	..	..	..
.	..	..	6.3	..	..	3.3	6.4	..	4.25	4.9	..	..
.	45.8	..	14.55	10.9	..	12.9	12.5	..	14.6	15.0	19.2	20.4
.	..	..	..	..	..	..	2.25	..	..	..	..	11.0
.	13.5	..	7.9	10.9	..	12.9	4.	..	8.4	15.0	19.2	9.4
.	32.3	..	6.65	..	..	..	6.25	..	6.2	..	..	..
.2	6.8	15.3	4.9	9.45	12.1	3.3	8.1	31.3	8.9	3.0	15.0	..
.1	4.4	..	2.0	9.45	..	3.3	5.8	5.4	3.7	1.3	10.5	..
2.1	2.4	15.3	2.9	..	12.1	..	2.3	25.9	5.2	1.7	4.5	..
..	..	..	..	..	..	..	..	..	..	..	..	..
0.8	71.3	11.9	35.7	58.95	88.4	56.25	40.0	134.7	14.8	25.6	32.4	42.8
..	2.55	9.2	6.9	4.4	11.6	9.6	6.3	15.9	3.6	3.5	8.9	24.0
0.8	19.4	2.7	13.55	13.25	21.7	8.8	4.6	15.1	8.0	6.8	7.7	7.1
..	7.4	..	2.5	9.6	19.4	6.8	0.9	11.5	..	..	1.5	..
..	1.3	..	1.7	0.9	12.8	2.8	2.6	10.5	..	1.8	2.5	..
..	9.4	..	1.9	..	5.2	5.2	9.7	19.1	1.8	..	6.5	..

	Total pages, Overn. 12 books	Total pages, Iler, 13 books	Total pages, 25 books	No. of authors treating—Overn	No. of authors treating—Iler	
	A	B	C	D	E	
4. Winds, cyclones, anti-cyclones	100.65	55.8	156.45	11	10	1
5. Local storms, showers, thunder-storms, tornadoes	36.5	29.7	66.2	7	7	1
B. Climate and seasons:						
1. Seasons caused by earth movements	31.0	35.9	66.9	7	7	1
2. Factors determining climate	24.7	16.9	41.6	6	6	1
3. Climate in relation to life	14.4	22.1	36.5	2	5	
4. Climatic influences of bodies of water	15.1	22.3	37.4	3	5	
XVII. Water, uses and supply	376.8	372.6	749.4	11	13	1
A. Value to man, properties, uses	78.20	151.9	230.1	3	12	1
B. Soil water, ground water	70.85	16.3	87.15	7	5	1
C. Rural water supply, wells, springs	40.55	22.1	62.65	5	7	1
D. City water supply	95.05	61.8	156.85	8	9	1
E. Water supply and disease, plumbing	67.95	71.2	139.15	11	10	1
F. Water and commerce, river, ocean traffic	24.2	49.3	73.5	4	7	1
XVIII. Erosion and soil formation	131.45	94.4	225.85	6	8	1
A. Weathering and wind erosion	34.45	14.2	48.65	6	5	1
B. Work of running water	65.2	45.6	110.8	6	6	1
C. Work of glaciers and lakes	30.1	14.2	44.3	4	5	
D. Soil decay, cycles of change	1.7	20.4	22.1	1	6	
XIX. The earth as a planet	193.15	233.2	426.35	8	10	1
A. The solar system:						
1. The sun and moon	43.9	86.0	129.9	8	8	1
2. Planets and comets	92.4	95.0	187.4	8	6	1
B. Stars	56.9	52.2	109.1	8	8	1
XX. Rocks and topography	158.0	67.9	225.9	6	5	1
A. Mountains	23.35	1.8	25.15	3	1	
B. Volcanoes, geysers	27.7	11.2	38.9	3	2	
C. Rocks and building stone, brick	37.9	29.1	67.0	5	5	1
D. Minerals and ores	15.25	11.1	26.35	2	2	
E. Continents and oceans	24.6	..	24.6	2	0	
F. Topographic maps	8.75	..	8.75	1	0	
G. Great plains of U. S.	1.6	..	1.6	1	0	
H. Changes in the earth's condition	18.85	14.7	32.95	1	3	

20 major topics (XX)
81 A, B, etc.
54 1, 2, etc.
20 a, b, etc.

Total 175

131 items of analysis
XX summaries

TABLE III—*Continued*

Total pages, 25 books	No. of authors treating—Overn	No. of authors treating—Her	Total no. of authors treating	Least and greatest page space	Open Doors to Science	First Year of Science	Everyday Problems in Science	Snyder, General Science	Elements of General Science	Science for Boys and Girls	Common Science	Early Steps in Science	Bowden, General Science
C	D	E	F	G	1	2	3	4	5	6	7	8	9
156.45	11	10	21	0.9-20.6	..	4.2	2.4	9.6	8.3	0.9	..	8.9	7.4
69.2	7	7	14	0.7-12.3	..	6.2	..	3.2	3.7	..	..	5.7	1.3
63.9	7	7	14	1.4-11.0	..	3.0	3.3	6.2	11.0	..	..	3.2	..
41.6	6	6	12	1.3-11.3	..	2.2	6.4	2.3	2.1	..	..	..	2.1
36.5	2	5	7	2.6-11.1	..	..	3.5	..	5.5	..	..	4.6	2.6
37.4	3	5	8	1.0-11.0	..	1.5	..	3.9	11.0	..	..	3.4	..
749.4	11	13	24	7.5-65.45	20.8	23.1	19.8	49.0	53.1	7.5	12.2	21.0	56.2
230.1	8	12	20	1.2-32.5	2.1	12.0	..	11.0	24.5	7.5	12.2	7.9	32.5
87.15	7	5	12	0.5-11.5	..	0.5	..	6.3	5.2	..	..	2.4	..
62.65	5	7	12	0.8-13.45	11.1	0.8	..	1.7	2.0	..	..	..	3.2
156.85	8	9	17	2.0-18.05	3.6	2.8	16.0	4.1	7.2	..	..	2.0	6.0
139.15	11	10	21	1.0-18.7	4.0	4.1	3.8	12.0	8.7	..	..	8.7	8.8
73.5	4	7	11	1.0-15.0	..	2.9	..	13.9	10.5	..	..	..	6.0
225.85	6	8	14	2.0-50.8	..	3.2	..	19.6	19.4	..	..	14.7	12.2
48.65	6	5	11	0.9-10.3	..	..	..	5.7	2.2	..	..	3.1	..
110.8	6	6	12	1.2-21.6	..	..	..	7.3	6.2	..	..	10.2	12.2
44.3	4	5	9	1.4-17.2	..	..	..	5.7	2.1	..	..	1.4	..
22.1	1	6	7	0.7- 8.9	..	3.2	..	0.9	8.9	..	..	..	..
426.35	8	10	18	5.0-47.8	..	36.9	24.6	47.8	29.0	..	15.5	43.2	7.9
129.9	8	8	16	1.5-15.5	..	13.1	7.2	9.7	7.0	..	15.5	15.0	5.3
187.4	8	6	14	2.5-27.5	..	16.8	13.5	27.5	11.5	..	..	20.7	..
109.1	8	8	16	0.6-14.55	..	7.0	3.9	10.6	10.5	..	..	7.5	2.6
225.9	6	5	11	2.7-62.85	..	4.5	13.3	22.5	..	..	..	16.7	..
25.15	3	1	4	1.8-9.55	..	..	..	1.8	..	..	..	..	..
38.9	3	2	5	5.1-14.6	..	..	..	5.1	..	..	..	6.1	..
67.0	5	5	10	2.7-13.3	..	4.5	13.3	4.8	..	..	..	3.6	..
26.35	2	2	4	4.1-10.	..	..	..	4.1	..	..	..	..	..
24.6	2	0	2	11.6-13.	..	..	..	..	..	..	..	..	..
8.75	1	0	1	8.75	..	..	..	..	..	..	..	..	..
1.6	1	0	1	1.6	..	..	..	..	..	..	..	..	..
32.95	1	3	4	1. -18.85	..	..	..	6.7	..	..	..	7.0	..

ntinued

Common Science	Early Steps in Science	Bowden, General Science	Civic Science in Community	Science of Common Things	Bedford, General Science	Civic Science in Home	Everyday Science	Science of Home	Science of Everyday Life	Elements of Gen. Science	Elementary Gen. Science	Introduction to Science	Lake, General Science	First Course in Gen. Science	Elhuff, General Science	Introduction to Science	First Year of Science	First Course in Gen. Science
7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
..	8.9	7.4	4.3	7.1	2.7	..	12.5	..	6.35	8.5	17.7	15.2	7.5	20.6	1.4	4.1	3.3	3.5
..	5.7	1.3	3.3	..	6.3	..	3.75	..	..	4.5	..	7.85	5.4	12.3	..	..	2.0	0.7
..	3.2	..	1.4	..	7.3	..	5.7	..	2.8	5.9	..	..	1.7	7.3	..	3.4	..	4.2
..	..	2.1	..	1.8	..	..	5.5	..	..	1.6	..	..	1.3	11.3	..	1.7	..	3.3
..	4.6	2.6	5.9	..	..	..	..	..	..	..	..	..	..	11.1	..	3.3	..	..
..	3.4	..	2.5	..	..	..	3.8	..	..	10.3	..	..	..	..	..	1.0	..	..
12.2	21.0	56.2	25.1	35.7	33.3	10.8	41.4	13.4	33.4	30.0	26.75	65.45	32.95	62.3	22.55	22.8	20.8	..
12.2	7.9	32.5	10.3	20.8	8.3	2.8	12.15	..	4.05	..	11.4	..	18.95	2.6	10.7	1.2	17.2	..
..	2.4	..	1.9	..	..	..	10.55	..	9.55	9.7	..	11.0	8.75	11.5	..	9.8	..	..
..	..	3.2	0.8	2.5	..	..	2.5	12.9	..	..	..	9.5	2.2	13.45	..	..	..	..
..	2.0	6.0	2.0	8.1	10.0	..	8.05	..	17.6	6.7	12.55	18.05	..	16.05	8.45	7.6	..	..
..	8.7	8.5	9.1	4.2	..	8.0	1.8	5.5	1.0	6.6	2.8	17.25	3.1	18.7	3.4	4.2	3.6	..
..	..	6.0	1.0	..	15.0	..	6.35	..	1.2	7.0	..	9.65	..	..	..	..	..	..
..	14.7	12.2	11.5	..	11.8	2.0	50.8	..	..	16.0	..	..	16.3	..	..	23.9	5.1	19.35
..	3.1	..	0.9	..	2.3	..	10.3	..	..	8.5	..	..	7.2	..	..	4.4	2.3	1.75
..	10.2	12.2	8.5	..	1.2	..	21.6	..	..	7.5	..	..	6.8	..	..	19.5	1.4	8.4
..	1.4	..	1.4	..	3.6	..	17.2	..	..	..	..	..	2.3	..	..	..	1.4	9.2
..	..	..	0.7	..	4.7	2.0	1.7	..	..	..	..	..	..	..	..	..	..	..
15.5	43.2	7.9	5.0	..	18.2	5.1	34.7	20.5	5.0	35.55	39.0	..	22.4	..	6.3	..	..	28.1
15.5	15.0	5.3	..	..	13.2	..	3.	6.4	1.5	12.8	5.6	..	2.4	..	2.5	..	..	9.7
..	20.7	..	5.0	..	..	..	21.85	9.5	2.5	12.4	18.85	..	14.8	..	3.2	..	..	9.3
..	7.5	2.6	..	..	5.0	5.1	9.9	4.6	1.0	10.35	14.55	..	6.8	..	0.6	..	..	9.1
..	16.7	..	10.9	..	..	..	62.85	..	2.7	..	..	10.7	..	..	..	17.1	6.2	58.45
..	..	..	..	..	..	..	9.55	..	..	..	..	..	..	..	..	5.9	..	7.9
..	6.1	..	..	..	..	..	14.6	..	..	..	..	..	..	..	..	5.6	..	7.5
..	3.6	..	2.9	..	..	..	..	..	2.7	..	..	10.7	..	..	..	5.6	6.2	12.7
..	..	..	7.0	..	..	..	5.25	..	..	..	..	..	..	..	..	..	..	10.
..	..	..	..	..	..	..	13.0	..	..	..	..	..	..	..	..	..	..	11.6
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	8.75
..	..	..	..	..	..	..	1.6	..	..	..	..	..	..	..	..	..	..	..
..	7.0	..	1.0	..	..	..	18.85	..	..	..	..	..	..	..	..	..	..	..

first number in each column gives the order of the books in terms of the items concerned. For instance, Bowden stands first in the page space devoted to principles; he is fourth, however, in the percent of his total printed matter devoted to principles. Clute discusses a larger number of principles than any other general science text and also has a larger number of applications.

TABLE IV

Analysis of General Science texts in principles and applications

	APPLICATIONS						
	Pages devoted to Principles	Per cent printed matter on Principles	Number of Principles, 93 all books.	Number of Applications	Per cent of pages to Principles	Per cent to Problems	Per cent Exercises to Problems
Barber 1916	4-30.	9- 6.55	11-27	18- 43	9- 5.02	16- 3.43	1.39
Bedford '21	18-12.7	13- 4.91	18-18	4-161	14- 3.34	8- 5.53	0.71
Bowden '23	1-42.65	4- 8.20	6-31	14- 90	4- 6.85	11- 5.08	0.94
Brownell '18	11-22.02	7- 7.76	4-34	20- 34	7- 5.70	20- 1.18	....
C. & E. (1918)	2-35.42	2-12.08	5-32	6-144	2- 8.97	3- 9.47	....
Clark '15	14-19.32	14- 5.41	12-27	12-100	17- 4.14	5- 8.67	2.49
Clute '17	5-29.56	1-12.11	1-45	1-338	1-10.05	2-11.31	....
Coulter '17	15-18.65	5- 8.10	14-26	16- 63	5- 6.57	7- 5.71	....
Elhuff '16	6-29.34	3- 8.58	9-30	13-100	3- 7.02	15- 4.03	0.32
Hessler, 1st yr. of Sci. '19	13-19.68	17- 4.98	13-27	3-195	15- 4.30	9- 5.46	....
Hunter & Whitman Com. '22	19- 5.	19- 1.63	19-10	17- 60	19- 1.21	12- 5.01	9.32
Pease '18	17-14.35	10- 6.18	7-31	15- 68	13- 4.44	18- 2.63	....
Pieper & B. '25 ..	9-23.95	11- 6.16	8-31	2-244	10- 4.68	10- 5.44	2.05
Smith & J. '20 ..	8-27.50	16- 5.00	15-24	7-127	11- 4.53	17- 2.84	0.63
Snyder, Everyday Sci. '19	3-33.59	6- 7.87	2-41	11-102	6- 6.07	1-19.90	17.19
Tower & L. '22 ..	16-15.13	13- 5.63	17-21	8-112	18- 3.96	4- 9.44	4.51
Trafton '20	20- 4.87	20- 1.10	20- 7	10-107	20- 0.88	13- 4.26	1.83
VanB. & Smith '23	12-21.10	15- 5.24	10-30	5-148	16- 4.29	6- 7.84	4.43
Webb & D. '24 ...	7-28.00	12- 5.98	3-36	9-111	12- 4.47	14- 4.13	1.68
Weckel & T. '16 ..	10-22.74	8- 6.85	16-24	19- 35	8- 5.29	19- 2.07	....

Not only must a principle of science be understood but enough drill must be given in the solution of problems under each principle to make it probable that the pupil will apply such a principle when he meets a problem that requires it in actual life situations. It seems important, therefore, that a text book which undertakes to give a mastery of the principles most commonly needed in the control of the environment should also have a good many problematic applications of such principles.

It is evident that general science text books are not devoting much space to a mastery of the principles of science. A little over 12 per cent of the printed matter is the maximum space devoted to principles. It is further evident that the treatment of these principles must be in most cases exceedingly brief. In Clute's book in which 45 principles are treated slightly less than 30 pages are devoted to their treatment, about 10 per cent of the book. There is an additional 11 percent (11.31%) devoted to the discussion of problems under these principles.

Tower and Lunt introduce a discussion of 17 principles in a little over 15 pages, which is 5.63 per cent of the total printed matter in the book. They have, however, 112 applications of these principles, making up nearly 14 per cent of the book. If the principles selected are the most important ones from the point of view of a mastery of environment, it would seem that such a treatment of a few principles with a good many applications of them would be a better procedure than a study of a large number of principles with relatively few applications.

A detailed study of this thesis of Mrs. Heinemann's shows that there is little unanimity among authors as to which science principles are of greatest importance at the general science level in the schools.

Eleven Electric Slaves for Each American Family

The estimated output of nearly 80,000,000,000 kilowatt-hours of electric power for the United States in 1927, if it could be converted into equivalent man-power, would provide the average family of about four persons in the United States with the services of eleven able-bodied mechanical laborers working eight hours daily, including Sundays and holidays, at a total cost for the eleven of about $75 a year.

The total production of electricity by public-utility power plants in 1927 is estimated by the Department of the Interior, through the Geological Survey, at about 79,700,000,000 kilowatt-hours, an increase of about 8 per cent over the output for 1926, which was 73,791,000,000 kilowatt-hours. The estimate for 1927 is based on reports of monthly output of electricity by public-utility power plants for the eleven months January to November and estimated figures of output for December.

Objective Measurement in General Science

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Standardized tests have been developed in answer to the demand for devices to objectively measure certain mental qualities, abilities and skills. Numerous studies have been reported showing the unreliability of teachers' marks based on subjective criteria. Many forms of objective tests of students' achievement are now available in each of the subject-matter fields. The Powers General Science Test, prepared in two forms, Form A and Form B, is the most recent to be developed in this field.[1] This paper reports the results obtained in standardizing the tests, a study carried out under the direction of Professor S. R. Powers of Columbia University, the author of the tests.

At the close of the school year of 1927 both forms were given to pupils in eleven selected school systems who were completing a year's work in general science. Norms were computed from the results. Each form of the test consists of one hundred multiple choice items. The difficulty of each item has been determined from the percentage of correct responses made by 300 pupils to each item. The most difficult item of Form A was answered correctly by but 9 per cent of the 300 pupils, and the easiest item was answered correctly by 94 per cent. The most difficult item of Form B was answered correctly by but 5 per cent, and the easiest item by 96 per cent.

It might be interesting to note the items found easiest, of median difficulty, and the most difficult. The easiest items in Form A were:

1. The most effective way to get rid of flies is by: 1. fly traps, 2. fly paper, 3. fly poison, 4. swatting, 5. destroying breeding places.
2. Water rises under the piston of a lift-pump when the piston is raised because of: 1. buoyancy, 2. air pressure, 3. diffusion, 4. pull of the piston, 5. capillary attraction.
3. Water enters a plant through the
1. stem, 2. flower, 3. root hairs, 4. leaves, 5. medullary rays.

[1] Published by the Bureau of Publications, Teachers College, Columbia University, New York.

4. Green plants manufacture food only
   1. at night, 2. in presence of light, 3. when it rains, 4. in the early morning, 5. under all ordinary conditions.

The easiest items in Form B were:

1. The telephone was invented by
   1. Morse, 2. Bell, 3. Edison, 4. Whitney, 5. Marconi.
2. The term humidity refers to
   1. Moisture, 2. oxygen, 3. expansion, 4. buoyancy, 5. carbon di.-oxide.
3. Gasoline is obtained from
   1. coke, 2. coal tar, 3. wood, 4. petroleum, 5. coal.
4. When a glowing splint is placed in a jar of oxygen it soon goes out because of insufficient
   1. hydrogen, 2. nitrogen, 3. carbon dioxide, 4. oxygen, 5. water vapor.

The items of median difficulty on Form A were:

1. A person who does not contract disease when exposed to the germs which cause it is said to be
   1. vaccinated, 2. inoculated, 3. immune, 4. contaminated, 5. quarantined.
2. Average air pressure at sea level is sufficient to support a column of mercury to a height in inches of about
   A. 24 B. 27 C. 30 D. 48 E. 100
3. Artificial silk is made from
   1. straw, 2. wool, 3. waste paper, 4. cotton, 5. linen.
4. The exchange of materials between the blood and body cells takes place through the
   1. aorta, 2. corpuscles, 3. arteries, 4. glands, 5. capillaries.

The items of median difficulty on Form B were:

1. The cooling effect noticed when a person perspiring freely is exposed to a draft is due to
   1. poor circulation, 2. overheating, 3. condensation, 4. exhaustion, 5. evaporation.
2. House flies lay their eggs in
   1. water, 2. mud, 3. grass, 4. manure, 5. crevices in the walls.
3. The periods of the year when days and nights are equal are called
   1. solstices, 2. meridians, 3. parallels, 4. equinoxes, 5. seasons.
4. Changing a liquid to a gaseous state is called
   1. condensation, 2. precipitation, 3. evaporation, 4. capillarity, 5. contraction.

The most difficult items on Form A were:

1. The circulation of water in a hot-water system is due chiefly to
   1. conduction, 2. radiation, 3. diffusion, 4. contraction, 5. capillarity.
2. The horse-power is a unit that measures
   1. work, 2. energy, 3. force, 4. time rate of doing work, 5. strength.
3. The temperature of the land which touches a large body of water is
   1. unaffected by the water, 2. warmer, 3 colder, 4. less variable, 5. more variable.
4. The essential parts of a dry cell are two electrodes in contact with a pasty mass containing
   1. sulfuric acid, 2 table salt, 3. copper sulfate, 4. ammonium chloride, 5. lead.

The most difficult items on Form B were:

1. As a quantity of water changes from liquid to ice its temperature
   1. decreases, 2. remains constant, 3. increases, 4. drops to a minus 4 degrees C., 5. rises to 4 degrees C.
2. Water has its greatest density at
   A, 0 C. B, 1° C. C, 2° C. D, 4° C. E, 10° C.
3. The lightest element is
   1. helium, 2. oxygen, 3. argon, 4. radium, 5. hydrogen.
4. Animal forms which consist of but a single cell are called
   1. bacteria, 2. molds, 3. insects, 4. embryos, 5. protozoa.

Validity of the Test

A test is valid when its measure of an ability corresponds to other objective measures of that ability. The validity of a test is usually determined by finding the correlation between the test and some independent criterion. Approximately 1,000 preliminary test items were secured through a careful analysis of textbooks and courses of study in general science. The 100 different items finally used in each form of the test were selected in part on the basis of experimental trial and in part on the basis of judgment of teachers experienced in teaching general science.

Statistical evidence of the validity of the tests for rating pupils was secured from correlating test scores with teachers marks, marks on the New York Regents Examinations and Intelligence Quotients. These coefficients of correlations are given in the following table:

TABLE I

VALIDITY OF THE TESTS

Form	*Cases*	*Measure Correlated*	*Coefficient*
A	64	School Marks	.71 ± .04
B	63	School Marks	.59 ± .05
A	64	Regents' Marks	.68 ± .05
B	63	Regents' Marks	.67 ± .05
A	99	Intelligence Quotients	.52 ± .05
B	97	Intelligence Quotients	.57 ± .05
A	127	Intelligence Quotients	.47 ± .05
B	127	Intelligence Quotients	.56 ± .04

The above coefficients indicate that the test has a relatively high validity for measuring accomplishment in general science.

Reliability of the Test

A test is said to have high reliability if, when a group repeats the test, each individual makes a score which is close to his first record. Consistency of results determines reliability. In practice the reliability is usually computed by correlating the scores made on the test by a given group of students with the scores made on a duplicate or different form of the test by the same students. The reliability coefficient was obtained by correlating the scores of 472 students who took both Form A and form B of the test. The coefficient of .85 ± .01 may be taken as indicative of the reliability. By using Spearman's or Brown's prophecy formula the effect on the reliability of the test of doubling the length of it can be secured. The effect of increasing the number of items on each form to 200 would raise the reliability from .85 to .92. The sigma deviation of the scores on each form is about 15 points, while the probable error of a score made by a pupil is 3.8. This means that the true score of a pupil making, for example, 44 on the test, lies within the limits of 40 and 48. Expressed in another way, it means that 50 per cent of the obtained scores are in error (as compared with their true score) by not more than ± 4.0 points.

TABLE II

RELIABILITY COEFFICIENTS

Correlations Between Forms A and B

School	*Cases*	*Coefficient*
1	171	.92 ± .01
2	120	.75 ± .03
3	86	.79 + .03
4	95	.75 + .03
1, 2, 3, 4	475	.85 + .01

The norms for the test were computed from the scores of 881 students on Form A, and 878 students on Form B. The mean score and the number of cases for each of the eleven schools which co-operated in the experimental use of the tests is given in the following table:

TABLE III

NORMS FOR THE TESTS

Schools	*Cases*	*Form A*	*Schools*	*Cases*	*Form B*
1	171	66.7	1	171	64.0
2	121	47.7	2	120	51.8
3	88	45.8	3	88	45.6
4	99	52.8	4	97	46.6
5	69	45.9	5	48	53.1
6	99	44.2	6	93	45.4
7	94	44.5	7	80	45.5
8	..	...	8	118	41.7
9	42	39.4	9	..	...
10	64	47.7	10	63	50.7
11	34	44.6	11	..	...
Total	881	50.1	Total	878	50.3

With one exception, the mean scores of the boys in each of the different schools was higher than the mean scores of the girls. The means on each form for all cases of boys and girls are as follows:

TABLE IV

MEAN SCORES OF BOYS AND GIRLS

	Form A	*Cases*	*Form B*	*Cases*
Boys	52.2	454	52.6	473
Girls	47.9	329	47.2	342

Interpretation of Scores

Individual pupil, class and school scores may be interpreted by comparison with the norms indicated in the following table:

TABLE V

	Form A	*Form B*
Lowest score	10	16
90% exceed	34	35
75% exceed	42	42
50% exceed	50	50
25% exceed	60	59
10% exceed	73	68
Highest score	95	95
Cases	881	878

A score of 34 or less indicates that 90 per cent of the pupils whose scores were used in determining the norms did better. If the score is 73 or more, it is evident that only 10 per cent of the experimental group did as well. When the norm of a class or school falls considerably below the norms of the tests, the general science instruction in that particular class or school is in need of diagnosis. It may be that the school is below average in mental ability, a condition reflecting itself in subject-matter achievement. If the class or school is not below average in intellectual ability, the efficiency of the general science instruction may well be questioned. It also may be true that the subject-matter materials in the particular course being given are unique. In this case, the teacher and school officials should seriously consider the worthwhileness of the materials being presented. Poor scores are likely to be a result of inefficiency, if instruction is not what it should be. If there is a suspicion that this is the case, the teacher should make a careful self-diagnosis of his teaching, noting which phases of the work were most successfully and least successfully given, and make efforts to improve defects revealed. If the mean scores of the class or school are considerably above average, it is an indication that the general science instruction in this class or school is being effectively given. The manual of directions states that "Teachers and supervisors of general science will find the test valuable for each of the following purposes:

1. It furnishes the pupil an objective measure of his accomplishment and of his standing in the group to which he belongs.
2. It furnishes a basis for comparison of accomplishment in different classes and for comparison of accomplishment in different schools.
3. It furnishes objective criteria for assigning marks, making promotions, reporting to parents, determining honors, etc.
4. A pupil's score on the test is in some measure a prediction of his ability to do successful wofk in specialized courses in science, such as later courses in biology, physics and chemistry.
5. The test will be useful in school surveys for studying the efficiency of a school."

Of course, the mere giving of the test and determination of the scores falls far short of the possibilities of the test. The usefulness of it comes from the applications made of results to the improvement of instruction.

The fourteen-year-old group seem to do consistently better work than other age groups. This would indicate that children of normal age for grade have a higher average degree of accomplishment in general science than under-age and over-age children.

TABLE VI

RELATION OF CHRONOLOGICAL AGE AND MEAN TEST SCORES

Age	*Form A*	*Cases*	*Form B*	*Cases*
13	50.4	25	48.9	17
14	51.9	171	53.1	167
15	50.5	288	49.9	323
16	47.5	185	49.7	195
17	44.1	69	50.1	70
18	51.6	22	43.3	26

Tentative first semester norms have been secured from the scores of pupils who took the test in January, 1928.

TABLE VII

TENTATIVE FIRST SEMESTER NORMS

	Form A	*Form B*
Lowest score	9	10
90% exceed	20	22
75% exceed	24	28
50% exceed	30	36
25% exceed	39	43
10% exceed	49	52
Highest score	82	74
Total cases	398	234

Conclusions

1. The test has high validity as a measure of testing accomplishment in general science.

2. The reliability of the test is very satisfactory. Confidence can be placed in the test scores obtained. The chances are even that the true score is within four points of the score obtained.

3. Boys do consistently better work in general science than girls.

4. Pupils of normal age for grade do better in general science than those who are not.

5. There is an extremely great variation in the type and effectiveness of general science instruction being given in the various schools. This is indicated in the relatively great range in the mean scores of the various schools, ranging from 39.4 to 66.7. The sigma deviation of 15 points also emphasizes this fact.

6. Teachers need to constantly check the effectiveness of their instruction by the use and application of the results of objective tests.

Scales for Rating Pupils' Answers to Nine Types of Thought Questions in General Science

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TYPE VII.—RELATIONSHIP

What is the relation of sanitation to disease?

Pupil Answer. The relation of sanitation to disease is this. If you go near a person that has pneumonia or Scarlet fever or the measles why you are liable to get it. In order not to get it if you are going to a contagious disease person is to have some in your clothes that will keep the sickness away.

Criticism. This shows no knowledge of the question, except in some way an individual may be disinfected and thereby be protected from contagious diseases.

VALUE 1

Pupil Answer. Sanitation is keeping germs away.

Criticism. The writer shows very little knowledge of the question and gives merely a partial definition of sanitation. The statement says that sanitation is keeping germs away, stating it as the action and not as a result of the action (or of sanitation).

Value 2

Pupil Answer. If every thing was sanitary and everybody would wash (take a bath) every day, brush there teeth and not leave, dirty clotheing, and filthy oily rags and everything. We would not have the sickness we have today.

Criticism. Number 2 states that personal sanitation prevents sickness, whereas Number 1 states merely that it keeps germs away. The statements are rather vague and do not show that sanitation has prevented and destroyed many diseases. Personal cleanliness is emphasized at the expense of community sanitation.

Value 3

Pupil Answer. By means of sanitation many diseases have been prevented and destroyed. Sanitation is the best method of destroying disease.

Criticism. It is stated that sanitation has prevented and destroyed many diseases. Number 3 emphasizes sanitation from the viewpoint of the community, Number 2 the cleanliness of the individual. This answer does not explain that sanitation prevents and destroys disease, nor does it mention that the various places of man's habitation should be kept sanitary.

Value 4

Pupil Answer. Lack of sanitary conditions in the home, factory, stores, and every other habitation induces the breeding of germs that cause very bad diseases. Sometimes these diseases become very serious.

Criticism. This discussion contends that lack of sanitatary conditions induces breeding of germs and that sanitary conditions should exist in all places where man spends any of his time. The statements in Number 4 are too general and need amplification. The meaning of sanitation is not definitely stated nor are the means of sanitation, such as ventilating, sweeping, and so forth, mentioned.

Value 5

Pupil Answer. If every one was clean and neat about himself and home there would be less diseases. Some people do not ventilate there homes enough and do not dust, wash, sweep and scrub their homes and that allows germs to settle in dust and dirt.

Criticism. It is clearly shown that cleanliness is a part of sanitation as it prevents the settling of germs in dust and dirt. No examples are given of the means of communicating diseases, nor is it stated that germs breed and live in dirt and polluted soil about the home and the yard.

VALUE 6

Pupil Answer. If a house is kept clean and sanitary there is little danger of disease entering. Germs bread and live in dirt and poluted soil about homes and yards.

Sanitation keeps germs away and is the greatest enemy of disease. A pencil point holds germs that no one dreams of and when it is put into the mouth the germs are transferred into the body. Public drinking cups should not be used because they are sure to contain germs.

Criticism. The pencil point and the public drinking cup are cited as a means of communicating disease germs. The statement is made that germs breed and live in dirt and polluted soil about homes or yards. Number 6 speaks primarily of sanitation in connection with the individual, while Number 7 speaks in terms of the community. No mention is made of flies or mosquitoes or the necessity of eliminating their breeding places.

VALUE 7

Pupil Answer. Every person and place should be sanitary. If we do not have sanitation we have disease. If we have a place with rubbish and old dirty water standing around we are liable to get a disease from the bacteria. If our barnyards are not cleaned out flies hatch out and carry bacteria to our table. We should drain or pour oil on ponds and pools to keep the mosquitos from hatching. If everything is sanitary around our house we are not liable to catch disease.

Criticism. This discussion shows the danger of dirt as a germ habitation, of filthy barnyards as fly hatcheries, and of stagnant pools as mosquito breeding places: that is, it stresses the necessity of ridding the locality of bacteria carriers and their breeding places. Number 7 speaks mainly in terms of sanitation in hospitals and in the handling of milk is not mentioned. Discussion of other phases of sanitation, such as sewage disposal, water purification, street cleaning, and securing and marketing food are omitted.

VALUE 8

Pupil Answer. Disease generally is seen where there is not much sanitation. Dirt will breed disease quicker than anything else. In the slums where there is not much sanitation will be seen disease. If a thing is clean and very sanitary the disease germs are too few to make any trouble. Hospitals have to be kept sanitary. It is very important that our milk is coming from a sanitary source, because disease germs will breed faster in milk than in anything else. Other aids of sanitation are in the best methods of sewage disposal, water purification, street cleaning, and in securing and marketing of food.

Criticism. This paper states that there is need of sanitation in hospitals and in handling milk. It also speaks of the connection of sanitation with the best methods of sewage disposal, prevention of water purification, street cleaning, and in securing and marketing food. The need of sanitation in destroying breeding places of flies and mosquitoes is omitted. The discussion is less clear and definite than in Number 9.

VALUE 9

Pupil Answer. Sanitation prevents the spread of disease. First of all it aims to destroy the germs from the bodies of the sick, by proper sewage disposal, prevention of water contamination, etc., and second it tried to eliminate carriers of disease, by destroying breeding and feeding places of flies and mosquitoes, and by providing pure milk and food supplies, etc.

Criticism. Sanitation, according to this answer, is needed to destroy the breeding places of flies and mosquitoes in order to eliminate some disease carriers. It is shown that sanitation and disease are directly opposed to one another. No mention is made of the various public organizations that strive to foster healthful conditions nor is it brought out that there has been a noticeable increase in the average length of life due to sanitation.

VALUE 10

Pupil Answer. Organized efforts that provide for community cleanliness and safety deal with health preservation. The science of health preservation is called sanitation. This science teaches that best methods of sewage disposal, water purification, street cleaning, obtaining and marketing food, stamping out contagious disease, and such activities that provide for community welfare.

Various public organizations are continually striving to bring about healthful conditions in our food, homes and communities. Without these organizations our large cities would be much more liable to infection, and disease epidemics would be both more numerous and more serious. It is the combined efforts of such public officials that has so noticeably increased the average length of life in modern times.

Criticism. This discussion of the question is complete and clear. Mention is made of the noticeable increase in the average length of life, due to sanitation; also of the work of public officials and various organizations that strive to foster healthful conditions in our food, our homes, and our communities.

TYPE VIII.—REORGANIZATION

Trace the history of a piece of wood from the tree to its use in a piece of furniture

VALUE 0

Pupil Answer. A piece of cedar tree is made into a cedar chest to put all wearable cloths in it and to keep the moths from eating holes in the cloths.

Criticism. The answer is entirely off the question. It discusses the use of the cedar chest as a piece of furniture.

VALUE 1

Pupil Answer. The tree is cut from the woods, and carried to some milling factories to be planed and stained. Next it is probably taken

Criticism. The writer shows only a vague knowledge of the subject, but mentions the cutting of the tree and the mill. It is implied that the mill and the factory are the same, and that the tree is taken directly to the factory from the woods.

VALUE 2

Pupil Answer. The tree is cut down, taken to a mill, sent to a factory and made into furniture.

Criticism. This answer shows that the tree goes through three steps: the cutting, the mill, and the factory. The answer contains only one sentence, and there is, therefore, no discussion of the three steps mentioned above.

VALUE 3

Pupil Answer. It is chopped down and in the woods and then brought to the mill where it is made into boards. Then it is brought to the city to lumber yards. The furnisher Companys by it and make furniture out of it.

Criticism. This paragraph includes a little more of the history of a piece of wood. It states that the trees are made into boards at the mill. No mention is made of the lumber being treated before it is made into furniture.

VALUE 4

Pupil Answer. First the tree is cut down. After that the logs are hauled to the sawmill where it is cut into boards, thence by train to the furniture factory where it is treated and then used in furniture.

Criticism. These statements are worded more clearly and are easier to understand than those in Number 3. The logging operations and the process after reaching the factory are not as fully discussed as in Number 5.

VALUE 5

Pupil Answer. The tree is chopped or sawed down out in the forest regions of the United States. It is then brought or dragged down to the river where it is rolled, dragged or pulled down the river to the mills where is is sawed into lumber. It is then shipped to the factories where it is put into shape of furniture and then painted and shipped to stores to be sold.

Criticism. The logging operations are more fully discussed and a more complete story is given of the wood after it reaches the factory than in Number 4. Trimming the trees is not mentioned. The second sentence is not entirely true, as rail transportation is used almost exclusively in some sections of the country.

VALUE 6

Pupil Answer. It is first chopped down and trimmed. Next it is loaded on little truncks and sent to the mills or the let them float down the river to the mills.

They are next made clean. Then they put them in some machine which saws them into lumber desired.

The lumber is then sold to people who next make them up into furniture.

Criticism. Trimming the trees is spoken of in Number 6, but omitted in Number 5. Compared with Specimen 7, this paper does not give as many steps in tracing the history. The statement, "they are next made clean" is indefinite and needs explanation. No mention is made of grading the lumber.

VALUE 7

Pupil Answer. These are the steps a piece of wood takes to make furniture.

1. Tree is chopped down.
2. Brought down to the river by horses or trains.
3. Shipped by train or sent down the river to factories.
4. Here they take the bark of the tree, and cut into slabs.
5. Then shipped by train to manufacturing town where the manufacture furniture.
6. Here it is separated in its different grades.
7. Then it is sawed, planed, sandpapered, and made into smaller pieces.
8. Then it is sent to the various parts of the factory, where they make it into furniture, and it is painted, shellacked, or varnished, wherefore the people buy it from the stores, who the factory sells it to.

Criticism. This answer is more complete than Specimen 6. Grading the lumber and removing the bark are mentioned. It is really a list of statements rather than a development of the history of the process by means of a discussion. Seasoning is not spoken of.

VALUE 8.

Pupil Answer. The tree is cut down or chopped down and taken to the sawmills. If the mill is near a river, the trees are floated down the river in spring in great "drives." If no river is near, they are carried by railroads or by sleds. Here it is trimmed and cut in boards. It is then allowed to dry out or "season" for a year or so. It is then shipped to furniture factories lumber yards, houses, etc. In the factories it is made into the various articles.

Criticism. The history is traced by means of a discussion rather than merely listed statements. Mention is made only of the natural seasoning, the artificial kiln method being en-

tirely omitted. This answer also neglects to describe trimming the branches and bark and marking the logs off in lengths. The discussion is too brief and the steps are not as clearly presented as in Number 9.

VALUE 9

Pupil Answer. The tree is felled and trimmed of branches. Then it is marked into lengths of 12 to 16 feet, usually, depending on the use to which it is to be put, the location of branches, faults, etc. The methods of getting the logs from the forest varies with location. Usually they are hauled to a river during the winter, and floated down to the sawmill in the spring. They may be loaded directly on cars and transported thus.

At the sawmill the log is cut into planks and is trimmed of bark.

Then the wood must be seasoned. The best method is natural air drying, where the boards are put in sheds, (separated from one another) and air circulates about them. But this is such a lengthy process that kiln drying is often employed.

The wood is usually shipped direct to the furniture factory, which cares for its own further seasoning, and then makes the wood into furniture.

Criticism. This paper definitely mentions trimming off the branches and bark, and marking the logs into lengths. It explains the two types of seasoning, natural and kiln drying. It is not stated that the content is measured in board feet nor is the method of felling described.

VALUE 10

Pupil Answer. Trees to be felled are marked, and the direction in which each is to fall is marked by cutting a notch on the chosen side. Sawyers work in pairs in felling the trees. Next, trees are marked off and sawed into log lengths, care being taken to avoid knots, forks, and rotten places, and to cut so that the logs range from twelve to eighteen feet in length. The branches are trimmed carefully in order that the trunk may be shaved close but not gashed. The logs are next "scaled" or measured as to their content in board feet. The logging

operation is finished with transportation to the sawmill. Transportation may be by railroad or by water, the method depending upon the locality.

The next step is sawmilling. The logs are sawed into boards here, after the bark is removed.

The seasoning process, which comes next, is very important. Natural air-drying, though best in many ways, is being superseded by the more rapid kiln-drying or hot-air seasoning.

After being seasoned, the boards are shipped to furniture factories, where they are made up into furniture, after such additional seasoning as may seem necessary.

Criticism. Practically all important points of the process are discussed. The method of felling and the measurement of the lumber in board feet is mentioned. Number 10 states that length of cuts vary from 12 to 18 feet, rather than from 12 to 16 feet as mentioned in Number 9.

TYPE IX.—SUMMARY

Give a short summary of the process of making steel.

VALUE 0

Pupil Answer. Steel is made from iron. Different types of steel are tempered differently.

Criticism. This answer shows that the writer knew a little about steel, but does not in any sense summarize the process of making it.

VALUE 1

Pupil Answer. Steel is made by melting pig iron and heating it to a very high degree. The hotter it is heated the better steel is made.

Criticism. The only knowledge shown of the subject is that pig iron must be heated to a high degree. No attempt is made to tell about the method of heating the iron. No mention is made of the use of an air blast, or of oxygen and coke as included in the steps of the process.

VALUE 2

Pupil Answer. The ore is put in a blast furnace and coke is used to produce the heat. A hot air track is shot up through

the center of the furnace. The good part melts and is caught below. The oxygen which makes up the rest is used in melting it. Coke is burned to produce this much-needed intense heat.

Criticism. The use of air blast, oxygen, and coke is mentioned in the steps of the process, but the meaning is not clear. The next to the last sentence states that the good part melts, but no explanation is given as to what the good part is. The fourth sentence is meaningless.

Value 3

Pupil Answer. The iron is heated and all the carbon taken out, and the proper amount is blown in.

Criticism. This answer merely gives a concise statement or summary of the process, i. e. the removal of the carbon and the later addition of the proper amount. No discussion of the topic is given.

Value 4

Pupil Answer. They put iron ore into a large tank heat it then they take all of the carbon out. Put it into a large bowl and put the right portion of carbon back in.

This process is mostly done by taking and putting the right amount of carbon back in.

Criticism. This paper gives a clearer statement of the removal and the partial replacement of the carbon content than Number 3. The process is not so well described as in Number 5; no mention is made of the use of hot air, or of the removal of sulfur. The last sentence adds nothing to the content.

Value 5

Pupil Answer. Steel is iron purified.

The iron ore is put in a blast furnace along with limestone, coke and sand. These materials are put in the furnace from the top of the flue. Hot air is forced into the furnace from the bottom. This causes the coke to burn with a very great heat, causing the iron to separate from the O and sink to the bottom of the furnace where it is held in a reservair. The limestone and sand produce a substance somewhat like glass which also sinks to the bottom but floats on the iron. The gasses thrown off by this process are used to heat the air. This pig iron is very hard and brittle. It contains C and sulphur.

When this is removed from the pig iron it becomes steel. (soft and malleable).

Criticism. This is a much better discussion than Specimen 4. It speaks of the use of hot air and of the removal of sulphur. Some of the steps in the process of steel-making are given. The first sentence is not necessarily true.

VALUE 6

Pupil Answer. The steel is first heated and then a jet is open which lets air blow over the top of the melted steel. The air mixes with the carbon and removes it. A certain amt of carbon is then replaced and it is heated over.

Criticism. No clear explanation is given of what steel is. In the first sentence the statement, "Steel is first heated" is not true, as it is the iron which is heated. This answer also fails to mention that carbon is removed as CO_2, or carbon dioxide.

VALUE 7

Pupil Answer. Steel is just a process of taking out carbon and putting the right amount in. Iron ore is first heated white hot and put in large tanks. Here air is blown through it and the carbon mixes with the oxygene and forms (CO_2) carbon dioxide. It is the put in air tight containers and the right amount of carbon is added.

Criticism. This paper explains what steel is and speaks definitely of the carbon being removed in the form of CO_2, or carbon dioxide. The explanation is incomplete and needs amplification in order to be a complete definition.

VALUE 8

Pupil Answer. First the iron ore is mined and as its not found pure except in newly fallen meteorites, it has to be separated from all impurities. They place a layer of limestone, coal or coak and iron ore then this is "cooked" together and as the iron is heavier it settles to the bottom and the rest is drawn off.

There are three different processes of working steel. The old and best method is when you burn the carbon from the pig iron then put as much in carbon as you want then beat it into shape. The Bessemer process is a poorer process it is when the iron is put into a furnace and the flames are sent through

it until the right amount of carbon is burnt out. The third process of making steel is when they send flames over the iron until some of the carbon is burnt out then they add enough and beat it out. This steel is used to make the cutting edges of machines.

Criticism. Portions of three processes of making steel are discussed, the majority of the space being devoted to methods of removing the surplus carbon from iron. The use of charcoal and the cooling of melted pig iron by a blast of cold air to oxidize and remove impurities have been omitted. The first sentence does not deal directly with the subject. The discussion cannot be said to be a good discussion of any one process, but gives a smattering of several.

VALUE 9

Pupil Answer. One of the most used processes of steel making is the Bessemer. During this process the molten iron is placed so Oxygen passes through it and the carbon is taken out in form of CO_2. The wrought iron then is placed in an air tight box with charcoal around it. Carbon is placed in the iron making the proper amount of carbon in every portion of the iron and it comes out steel. A blast of cold air is blown against the melted pig iron thus oxidizing and aiding in the removal of such foreign matter as Silica, carbon etc. carbon is added to the metal either before or during the time of cooling.

Criticism. The following points are brought out in this paper: the use of charcoal, cooling pig iron by a blast of cold air to oxidize and aid in the removal of such foreign matter as silica, carbon, and so forth. This answer gives a good discussion of one process of making steel, while Number 8 tends to give only a smattering of several processes. No mention is made of the removal of sulfur; that the color of the flame is used as a signal when the process should cease; or of the moulding of the metal.

VALUE 10

Pupil Answer. The most common method of making steel is known as the Bessemer process. Here the melted pig iron is run into a converter, and a blast of air is blown thru it. This oxidizes and removes the silica, carbon and manganese. If the iron contains much sulfur, this has to be removed by an

additional process. The color of the flame from the air blast tells when the process has gone far enough. Then the molten metal is run out into the molds. Carbon is added, either as a lining of the mold which the steel absorbs as it cools, or to the metal before it is run out.

The purpose of the process is to remove the impurities, largely carbon, and to insure a proper carbon content of the metal.

Criticism. This is a good description of the important steps in the process. Sulfur is mentioned as sometimes being present in large enough quantities to require its removal by an additional process. It is stated that the color of the flame after the air blast is used to determine when the process has gone far enough. The moulding of the metal and the two methods of securing proper carbon content are described.

Science in the New Curriculum

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For several years the North Central Association of Colleges and Secondary Schools has had at work a large committee on the revision of the secondary school curriculum. The work of the committee is rapidly nearing completion and there have already been published the reports of several of the sub-committees. The reports on science, covering general science, biology, chemistry and physics, are available as a reprint from C. O. Davis, Ann Arbor, Michigan (University of Michigan).

The report of the sub-committee on mathematics is published in the March *North Central Association Quarterly,* 1928, and is available from the same person.

The curricula for all the high school subjects are treated in the same way. The generally accepted objectives of the N.E.A. Committee on Secondary Education are used in a slightly modified form. These, health, citizenship, wise choice of and efficiency in a vocation, etc., are taken as the basal objectives. Curriculum material, in part organized in units, is presented with a view to the achievement of these objectives. The work outlined is largely in qualitative form though a few bits are quantitatively expressed to indicate the sort of thing that still needs to be done.

There are presented here some brief excerpts from the report of the science committee just to show the character of the work that has been done:

GENERAL SCIENCE

3. KNOWLEDGE USEFUL IN THE CONTROL OF SITUATIONS OF EVERY DAY LIFE.

Illustrative material:

a. Facts pertaining to the problems of sanitation, and the prevention of diseases, applicable to all pupils. Elementary study of bacteria of different kinds; bodily resistance of disease germs; the spread of diseases, infections and contagions; the prevention of diseases through a knowledge of hygienic regulations.

b. Knowledge of the nature and function of the digestive organs: digestion of starch, fats, and proteids; hygiene of eating; effect of excessive use of condiments and stimulants; bodily nourishment through proper circulation of the blood.

c. Theory and practices of "first aid."

d. Quarantines, sterilizing, disinfection, etc.

e. General housing conditions of the community—pamphlets of committees on housing conditions in cities.

f. Hygienic lighting, ventilating, and heating of homes and of all public buildings and industrial plants.

g. Methods of destroying harmful bacteria,—heat, fumigation, antiseptic solutions, etc.

h. Civic prevention of disease through care of streets, sewerage, drainage, supervision of milk and food supply.

B. *Developing Attitudes, Interests, Motives, Ideals, Appreciations.*

Illustrative material:

1. Adolescent personal pride in the development of a strong physical body—Concrete material should be gathered from all available sources.

2. Study of tables and charts based upon thoroughgoing medical inspection in the schools and other institutions of the community.

3. Health conditions in relation to stagnant pools, swamps, canals, open wells, garbage cans, impure food, etc.

4. Scientific care of the sick in hospitals and sanitariums.

C. *Development of Mental Techniques in Perception, Memory, Imagination, Judgment, and Reasoning.*

Illustrative material:

1. Ability to distinguish between wholesome and harmful fruits, roots, plants, vegetables, etc.

2. Ability to judge as to the effects of drinks, narcotics, foods, etc.

D. *Acquiring Right Habits and Useful Skills in Living.*

Illustrative material:

1. Daily sanitary personal care of eyes, ears, nose, teeth, throat, stomach, skin, scalp, hair, nails, etc.

2. Regularity of habits in eating, sleeping, exercise, relaxation, and rest periods.

3. Skill in applying remedies for non-critical ills and diseases.

4. Practices of having blood corpuscle and blood pressure tests made at regular intervals during adult life especially.

BIOLOGY.

3. KNOWLEDGE WHICH IS USEFUL IN CONTROLLING SITUATIONS OF EVERY DAY LIFE.

The point of view and interest developed under (2) above will lead

to a study of the habits of birds, with a view of utilizing them to keep in check undesirable insects.

Plant the home grounds with trees and shrubs that are attractive to birds: to provide bird houses, baths, feeding shelves, etc.

Learn the life history of some common insect friends and foes.

Study the relation of hawks, owls and snakes to the control of rodent pests.

Study gamefish and their habits, so as to be able to restock local streams and lakes.

What could be done in the local community to reforest waste lands.

In all such studies the aim should be to secure a comprehension of the biological principles involved and not merely to memorize detailed facts. The principle applies to many problematic situations.

B. *Developing Attitudes, Interests, Motives, Ideals and Appreciations.*

Books and magazine articles that deal with the accomplishments of biologists in the problems of human welfare will be the chief instruments in securing these ends. The following titles are suggestive: Locy's "Biology and Its Makers," Caldwell and Slosson's "Science Remaking the World," Clodd's "Pioneers of Evolution," Davenport's "Domesticated Animals and Plants," Osborn's "The Age of Mammals," Hurlburt's "Forest Neighbors," Ingersoll's "Wild Life of Orchard and Field," Miller's "Four-handed Folk," Robert's "Watchers of the Trail," Job's "The Sport of Bird Study," Seton's "The Mammals of North America," Harwood's "The New Earth," Pack's "The School Book of Forestry," Sargent's "Plants and Their Uses."

C. *The Development of Mental Techniques in Perception, Memory, Imagination, Judgment and Reasoning.*

The biology teacher who will throw much of her work into problem and project form, and who will guide pupils in solving problems, not solve the problems for them, may hope to accomplish these ends. Why are weeks so successful? Why can you best make a willow whistle in the spring? What kind of trees do you find growing along the local river valley? How do you make a purple martin house? What occupations are the least subject to vocational diseases? Why do ants carry sand *into* their ground nests? Why does not the upstroke of a bird's wing undo the lifting effect of the down-stroke as it starts to fly?

D. *Acquiring Right Habits and Useful Skills.*

The biology teacher may help pupils to acquire ideals of accuracy in observation, clarity in expression, habits of orderliness in arranging data, of suspending judgment until the evidence is adequate, skill in selecting data that are pertinent to a problem, in presenting evidence in convincing form, in drawing conclusions.

The whole task is an ambitious one and since it has been accomplished by a combination of high school principals, school superintendents, teachers in the various fields, and experts in the pedagogy of the subjects, the result should be a very practicable curriculum. The committee does not flatter itself with the belief that the proposed curriculum is a final solution of the problem. It does believe, however, that the thoroughgoing and honest effort to build a curriculum for secondary schools on a uniform plan, is a long step in advance.

An Assembly Program: Edison

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Often when a program is to be presented by a pupil group the one and only object is to produce a fine result. To this end the best pupils in the class are chosen to present the program. The pupils chosen look up material, organize it and present it to the school in the form of a talk, play or demonstration. Most of the preparation is done outside of class, as a small group is usually concerned. Those pupils which most need the practice of speaking before a group, and have the greatest difficulty in organizing material for this purpose are usually the ones who are never selected.

The program which follows was prepared and presented by the whole class. The topic assigned to each member was selected with the need and ability of each individual in mind. The chairman chosen was not the most brilliant girl in the class but one who because of a tendency to be very quiet and retiring needed to be given opportunity for this sort of procedure. Those pupils who were not clear thinkers were directed so that they produced a short paragraph containing some technical idea that needed clear and concise explanation. The brighter and more rapid workers were given a topic on which there was considerable material and given practically free reign in organizing it.

Having decided on Monday that the following Friday would be a fit opportunity to present an Edison program (the following Saturday being his eighty-first birthday) the teacher's first step was to arouse in the class a desire to present such a program. The English teacher was consulted and agreed to help in putting the material into proper form. It was found that the science class would meet Tuesday and Wednesday and the English class Wednesday thus giving three class periods which could be allowed for preparation. On Tuesday the copies of "The Science Classroom" for that week were given out. This issue was devoted to Edison. It is the custom of this class to have a current events lesson every other Wednesday based on these sheets and current magazines. The attention of the class was called to the fact that this was an Edi-

son number and the hint that perhaps an assembly program would be in order was thrown out. The pupils in this school are always eager for such an opportuinty and immediately expressed their interest. The rest of the period was spent in discussing the material in the paper and planning a program. Topics were assigned to each pupil. Their attention was called to those books which were available in the school library and the assignment was made for the following day that each pupil should bring in a rough draft of the material to be included. The class met again the first period Wednesday. Each person presented her topic as she had outlined it. Overlapping topics were cut down and misunderstandings were cleared up. At the end of the period they were told to take their material to their English class which came later in the day. In this class each one was asked to write in good form what she was going to say. The English teacher assisted in developing this part of the work. The English assignment for Friday was to have their papers rewritten according to the suggestions and corrections made during the class period. As the assembly was to come the first thing in the morning, and they had neither Science nor English class in which to have the final paper looked over, each pupil brought his paper to either the Science or English teacher during Thursday or before school Friday morning for a final survey. It will be noticed that in two cases there was overlapping of material. This happened in both cases because the pupils failed to check up on their final product. They realized clearly after the program was over what the fault was and wherein they were to blame, and felt very keenly that they had to some extent marred the program. An incident of this kind probably has much more effect in training character than many lectures on the evils of neglecting work.

The program which follows is in the exact words of the pupils.

Chairman: "Tomorrow will be the 81st birthday of Thomas Edison, one of the oldest and most famous of inventors. Class V (grade eight) has decided to celebrate the occasion by giving a program about his life and inventions. The first two girls to speak will be Frances and Sophie who will tell us about two of the best-known achievements."

First Speaker: "Nights of old were considered nights of darkness, because there were no electric lights. People went home soon after sundown, and felt quite luxurious and satisfied with only a dimly flickering candle, because they knew of nothing better. Even Kings and Queens had nothing but a few candles in their palaces and yet they were satisfied.

"If Edison had invented nothing but the incandescent lamp he would always be remembered and have made his name live in history. He was only thirty-two years of age when he invented this. While he was making experiments and inventions in electric lights many other scientists were doing the same thing only without success.

"Edison worked day and night making experiments of all kinds, until he found that after a piece of sewing cotton thread had been carbonized it could be inserted into a lamp and make it burn for forty hours. Edison took so much interest in this that he would not close his eyes for sleep during the forty hours of this experiment.

"After this experiment he took interest in anything small like thread. One day he found a palm leaf fan that had a small binding, so he had it carbonized and inserted into another lamp as before. This proved to be the best obtainable up to that time so he sent some men to China and Japan to purchase bamboo that was like the binding of the fan. This was a great success and from this lamp came the original heating and lighting invention of today."

Second Speaker: "Imagine the world today without any electric lights, trains, etc. Yet it is only within fairly recent times that electricity has been used for these purposes.

"The Greeks did understand something of static electricity, and also about magnets. The Chinese used magnets for compasses.

"Galvani experimented on a frog, and by that experiment learned how to get electricity from batteries.

"Faraday found out that if you used a piece of copper near a magnet it would make an electric current.

"The dynamo is a machine for converting mechanical power into electrical energy. This was one of the most important inventions of Edison's. Edison took Faraday's idea and started the first power house in New York City, in 1882. Out of that grew all of the electric things that we have today.

"At an exposition in Berlin in 1879 Dr. Siemens exhibited a small electric locomotive. The track was one thousand feet long and ran in a circular position. Edison saw the practical importance of the motor. His first electric locomotive was built in 1880. He had a flat dump car, and put a dynamo on it.

"Improvements quickly followed and it was not many months before his motors were ready to propel the trolley cars we have today, and also the electric trains that we depend upon so much around the large cities, as they avoid smoke."

Chairman: "Jessie and Mary will now tell us something of Edison's contribution to the amusements we enjoy today."

Third Speaker: "The invention about which I am going to speak, perhaps affords the most public amusement. It is the moving picture camera.

"At first the movie cameras were just small objects with a slot and a crank. You look through the slot and turned the crank. You then saw a few pictures such as boys playing leapfrog.

"After awhile Eastman invented a film. This made Edison even more enthusiastic. He took it and made a machine so that he could really show pictures to the public in 1889 for the first time.

"He took a 320-foot film and got portions of the opera Martha with which he combined the phonograph. This lasted only five minutes. However, now, they last over two hours.

"He invented this at the age of forty-two just after the improvement of the phonograph."

Fourth Speaker: "Another of Edison's great inventions, about the eighth of any importance, is the phonograph, which also contributes largely to public amusement. He made this contribution to science in 1877 when he was but thirty years old. It was made while the inventor was working on the telephone transmitter.

"Knowing that sound caused vibration in a diaphragm he attached a small needle to one and drew it rapidly across a sheet of paraffined paper, shouting into the phone while doing so. When he looked at the sheet he noticed that the grooves varied with the strength of his shouts. As the paraffin was too soft, in later experiments he used tin foil. He next made the machine into a cylinder around which he wrapped the

tin foil. On August 12, 1877 the first phonograph record was made with the words of the well-known nursery rhyme 'Mary Had a Little Lamb.' In 1886 he improved on it, inventing the wax cylinder and later still the disc record. Edison is the first person ever to have attempted to make a machine speak or sing. Out of all his great inventions he wishes to be remembered by his phonograph."

Chairman: "Carol, Marion, Gladys, Miriam, and Betty will tell us about some of the less known inventions."

Fifth Speaker: "Edison's first important work for the Western Union was an improvement upon a system of duplex telegraphy, by which two messages could be sent over the same wire at the same time, in opposite directions.

"Bell invented an excellent telephone receiver but no transmitter. Edison was the first man to perfect both receiver and transmitter. When he had perfected the transmitter, Mr. Orton of the Western Union telephoned Edison and asked him how much he would sell it for. Edison thought about $25,000 but hesitated to ask that price, because it seemed to him a good deal of money to pay. So he asked Mr. Orton to make him an offer. To his surprise, Mr. Orton offered him $100,000 which he readily accepted. The phonograph, the telephone, and the transmitter that Edison invented were made through trying to improve on the telegraph.

"Although Edison was not the actual inventor of either of these, his work with the multiple telegraph and automatic and recording telegraph greatly speeded up their practical use and his invention of the carbon transmitter made possible long distance telephony."

Sixth Speaker: "Edison invented a three-wire system to save copper. Electricity is carried to different buildings by means of three wires. The wire on the outside is negative, the wire on the other side is positive, while the middle wire is positive to the negative wire and negative to the positive wire. Before Edison invented the three-wire system it was necessary to use four wires instead of three for the transmitting of two currents."

Seventh Speaker: "From the time Edison was forty-four until he reached the age of fifty-three he worked both day and

night on a method of crushing low-grade iron ore, separating it by means of magnets and then concentrating it into the form of briquettes for the smelters.

"His process was then the only means of acquiring iron for the mills of this country.

"With two million dollars worth of borrowed money he began to build huge plants in the state of New Jersey.

"Soon after this was begun the great deposits of high-grade iron ore were discovered in Minnesota and still more in Alabama. His plants and works now went for nothing as the new iron ore could be more cheaply mined.

"But Edison refused to be discouraged. To pay back some of his many debts he began working on some new inventions. Among these was a newer and easier process of manufacturing cement and the alkaline storage cell. Before giving this cell to the public he spent eight years of research on it and made nine thousand experiments. This storage battery is not used by our everyday cars but by those run by electricity and other things which need the high power that it gives out. It is now so perfected that Edison's description describes it completely—"Built like a watch but rugged as a battleship."

Eighth Speaker: "A few of Edison's other inventions are: the X-ray fluoroscope, the voting machine, the tasimeter, a speaking siren and the odoscope.

"The X-ray flouroscope is a method of making visible X-ray pictures. It consists of a screen coated with a chemical which glows when X-rays fall upon it. Thus if X-rays are allowed to fall on a person's hand, and then on the screen, the rays that penetrate the hand glow on the screen, while the ones that are stopped by bone leave a shadow on the screen. In this way we are able to see the bone.

"The voting machine is a method for making voting more private. At first this was not a success because the big politicians did not approve of it.

"The tasimeter provides a method for measuring extremely minute degrees of heat.

"The siren is a loud horn that will shout fire! fire! instead of just making a noise.

"The odoscope is used for measuring the strength of smells."

Ninth Speaker: "During the war, when Edison was already considerably over sixty, he gave over forty inventions to the War Department at Washington.

"Most of them concerned protection against submarines. There were also nets to stop torpedoes, methods of coating periscope lenses with oil to protect them from the water surface, plans for artificial clouds and many others. The War Department still keeps the details secret in most instances.

"Edison also derived a process for making synthetic carbolic acid. Working men twenty-four hours a day he completed a plant for this purpose in eighteen days and within four weeks he was producing one ton of chemical per day. In addition he built and operated benzol and other chemical plants.

"In the year 1914 his great works at West Orange burned; yet within thirty-six hours he had a new fire-proof structure under way.

"He has taken out over a thousand patents for his inventions and he is still working trying to out-do the late Luther Burbank in producing rubber from a milkweed vine. While working on this he has also been developing cocoanuts, thanks to some tips given him by Luther Burbank, who was also his friend. Edison is now the champion cocoanut grower in Florida and he has recently won two prizes at an exhibit, one for the best cocoanuts in the state and the other for the largest cluster."

Chairman: "Polly will tell us some anecdotes concerning Edison's life."

Tenth Speaker: "At an early age Edison became very interested in experimenting. He heard that a certain kind of gas would enable a person to fly. So he persuaded the chore-boy to take some powders containing the needed gas. But, instead of flying, he was stricken with terrible pains and Edison received a sound switching.

"By the time he was twelve, Edison had about two hundred bottles of chemicals which he labelled poison to keep everyone away from them.

"In order to have enough money to buy chemicals he had to go to work so he became a newspaper boy on a train. On this train was a smoking compartment which was not being used so Edison was allowed to use it for a laboratory. Once

while experimenting he set the car on fire and although he succeeded in putting it out the conductor who was very angry boxed his ears so severely that he has been deaf ever since.

"While working in a telegraph office he was very much disturbed by insects getting into his lunch so he made an arrangement that electrocuted all the insects that tried to eat his lunch.

"It is also said that while on night duty in the telegraph office he was supposed to send the letter 'A' every half hour to show that he was awake. So he made a machine that would automatically send the letter 'A' every half hour so he could go to sleep.

"When he was trying to sell his second invention, the stock ticker, he did not know how much to ask for it. $5000 he felt would be all right but decided to ask the buyer to make an offer. The offer was for $40,000. Edison has said that he never came nearer to fainting in his life.

"Quite recently he made the statement that genius was 1% inspiration and 99% perspiration."

Chairman: "Betty will speak about chronological accounts of Edison's achievements."

Eleventh Speaker: "America's greatest inventor, Thomas A. Edison was born on February 11, 1847. Although he was a boy of practically no advantages we owe him to date no less than seventy different major inventions.

"When Edison had reached eleven years of age he had become very much interested in the study of chemistry but soon went to work in order to pay for the chemicals which he used in his experiments. He received a position as a newsboy on the railroad. This led to a casualty, for one day while trying his experiments in one of the unused smoking compartments he set the car on fire, at which the conductor soundly boxed his ears and from that day to this Edison has been deaf.

"At the age of sixteen he became telegraph operator but soon also lost this job as he was continually falling asleep while on the job. From then on until he was twenty-three he went through many hardships but good was to come his way that year for he received forty thousand dollars for the stock ticker. Meanwhile he had invented the voting machine. This gave him renewed courage. At the age of forty-two he had succeeded in many inventions such as the telephone transmitter, the phonograph and the moving picture camera.

"Twenty years later he had succeeded in many other inventions and in his sixty-second year had completed the nickle iron storage battery.

"When seventy-one years of age he had, besides other inventions, completed fifty war inventions and now ten years later he is still busy on his eighty-first birthday trying to succeed in the act of producing rubber from milkweed."

Chairman: "Margreta will mention two or three of the improvements which have recently been made upon some of Edison's discoveries."

Twelfth Speaker: "The inventions which we owe to Thomas Edison are very numerous and varied. It is most surprising to think of the wonderful improvements that have been made upon them.

"Let us consider, for instance, the multiple telegraphy. This is an improvement upon previous methods of telegraphy, which makes it possible for twenty messages to be transmitted at once each way over a single wire, or forty messages in all. All the operator has to do is to run a special typewriter and the messages are automatically punched and sent over the wire.

"Then again there are the improvements upon the phonograph which in 1904 when the old cylinder record was used was spoken of as the 'all but perfect' phonograph. In those days a would-be listener needed to put tubes in his ears. Compare this with the new orthophonic victrola and the ones in which the sound is amplified by use of vacuum tubes.

"Then the combination of phonograph and moving picture with which Edison experimented, has led to the development of the Vitaphone which is now in use in over a hundred theaters, and the invention of the Phonofilm and Movietone. These last two turn the sound into a flickering light and take a picture of this flicker on the edge of the film with the picture. The projection apparatus changes the dark and light bands on the film back into sound by means of tubes like the radio tubes. One cannot measure the debt we owe to so great a man."

Chairman: "Perhaps tomorrow when Edison's birthday comes around for the 81st time you will all see his name mentioned in the paper and will think of all that we owe

to him. This program may have reminded you of some at least of his great inventions."

A program of this type may serve as a teaching device as well as an entertainment, in that it gives the opportunity for a large group to take part, work can be assigned according to the ability and needs of the person, and it can be tied closely with class work and discussion.

Nature's Harmony of Motion

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When one first considers nature and her processes he is struck with the number of facts to be observed and the multiplicity of phenomena to be explained. On further study he discovers a striking unity in it all, and is amazed to find that, after all, physical science is based upon rather few fundamental principles. One single law may serve to explain a multitude of apparently unrelated facts. Place a mass of star dust in some isolated corner of the universe, give to each grain the power of attracting every other grain with a force proportional directly to the product of the masses involved and inversely as the square of their distance apart—the well-known law of universal gravitation—and in time a planetary system will evolve. Then introduce into this system the force of chemical affinity, and the elements will arrange themselves in chemical forms with all of the intricacy and beauty of a dead inorganic world system. Finally add an additional something which we call vital force, then living organisms will appear and, in time, by the slow process of evolution, there is perfected a summer landscape. And all of this amazing detail of fact and pheonmenon finds its cause in the operation of certain simple forces.

As a result in a universe where few forces are acting, we would expect to find a creation capable of analysis and harmonious in its parts. We would expect to find agreement, nice adaptation of parts, similarity in forms and everything related so as to make a consistent and orderly whole. This we do find, and one of the first things to attract attention is

likeness of form. Nature, for example, is fond of the circle. The sun, planets and stars are spheres or nearly so. The earth is so nearly round that if reduced to the size of a golf ball, its amount of departure from a true sphere could hardly be recognized. A tree is an example of this same tendency on the part of living things. The trunk is round in perpendicular section and so are the branches. The cells of the sap and fibre tend to the same form and the yearly growths are in the shape of rings. Even the leaves are often roundish, sometimes quite round, as if struggling to fit themselves into a great plan of the Creator. Molecules, atoms and electrons are supposed by many of the best authorities to be nearly spherical in shape. Wherever we look we find the same tendency on the part of both dead and living things to fall into a harmony of form.

Circles, arcs, curves — what are they? Mathematical abstractions represented by strange formulæ difficult for the ordinary mortal to comprehend, but deprive us of them and you make creation an impossibility, rob the universe of form, leave nature without grace and make of art a caricature.

Let us now pass into the realm of moving things. Our earth moves around the sun in an orbit that is not far from a circle. All of the other planets likewise move in elliptical orbits with few exceptions quite nearly circular. Passing into the micro-world, we find that the best theory of the atom calls for a movement of electrons about a central nucleus in circular paths. In all the natural world where motions are uniform and sustained we find great preference for the circular or nearly circular type. Even living beings in some of their movements are partial to the circle. A fox pursued by dogs, they say, will run in a circle. Birds of prey soar skyward in circles and a man or animal lost in the forest or on the prairie in a snow storm will walk in a circle.

Suppose we look through a telescope off into space at a system containing a small satellite revolving around a planet in a circular orbit, and suppose further that we are so located that we view the system along a line in the plane of the orbit. Under these conditions the satellite seems to move to and fro along a straight line fastest when passing the planet at

the middle of its path and gradually slowing down as it approaches the two ends. Strange to say the apparent motion of this small heavenly body represents a type of motion quite common in the physical world and we give it a special name—Simple Harmonic Motion. Again it may be illustrated as follows: Hold a small object such as a baseball in the hand and move it around as nearly as possible with uniform speed in a circle whose plane is perpendicular to the east side of a building just after sunrise. The shadow of the object on the wall of the building will follow this interesting form of vibratory movement.

These two kinds of motion so nearly related that one may be made appear the other simply by viewing it in the proper direction are nature's favorites. Wherever we find a sustained periodic movement of matter we may expect one of these types. The vibrations of a weighted spiral spring, a simple pendulum and the balance-wheel of a watch are examples of the simple harmonic form.

The vocal cords of the throat in producing speech, the sound energy in the form of waves as it passes to the ear of the listener, the vibrations of the ear drum and even the little fibers of the basilar membrane where the nerves of hearing terminate—all have the same characteristic movements agreeing in a remarkable way with the shadow of the baseball in the illustration above.

The alternating current of electricity carried by two small wires into your house to give you light, cook your breakfast and do your work—this wave of pulsating energy follows the sinusoidal form and is almost a perfect example of the same general type.

The light coming from the lamps in your room, the streams of quiet energy proceeding from the sun which heat and illuminate the earth making life and growth possible are vibrations in a medium which extends throughout all space. After centuries of discussion and study authorities are now agreed that here too we have a periodic motion very precisely analagous to the kind we have had illustrated.

The air about us is filled with the song of birds and the call of insects, the propagation of which requires motions of like character. All space about us is carrying waves of noise-

less energy which only need a proper receiving device to translate into music and speech. These are very difficult to study but the researches of Faraday, Maxwell and Hertz have clearly proved that here again in radio waves we have a special case of the general class. The movements of great ocean billows and the delicate ripples on the surface of a pond, the swaying of a great tree after the passing of a gust of wind, the movement of a bough and the rustle of a leaf—about us everywhere we find movements in agreement with this favorite form.

Thus we find in nature, in addition to the easily recognized harmonies of form, of color and of sound, a quite usually overlooked harmony of motion, and yet here is something to stir the soul—all nature visible and invisible alive with energy, pulsating under the stimulus of unseen forces not in irregular and disorderly fashion but true to definite form. All the universe joyous in a splendid harmony of motion. It was a common belief among the ancients that the motion of the heavenly bodies through space produce delicate sounds which they called the music of the spheres. We may hear that music but not with mortal ears.

> "Heard melodies are sweet but those unheard
> Are sweeter; therefore ye soft pipe play on;
> Not to the sensual ear but more endeared,
> Pipe to the spirit ditties of no tune."
>
> —*Keats.*

Sources of Free Material for Science Instruction

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The use of industrial material and other visual aids is not new in science instruction. The value of such material is generally recognized. This is especially true in schools where there is a noticeable deficiency in laboratory or library facilities. And so without attempting in any way to justify the use of such material, the following compilation, collected, arranged and revised over a period of seven years, is presented for the use of those instructors who may be able to profit by the same.

The industrial material available may consist of catalogues, pamphlets, charts, exhibits, slides, films, descriptions of manu-

facturing processes, research bulletins and educational monographs. The list that follows is most valuable for those desiring industrial or educational exhibits and the accompanying bulletins.

A general, indefinite request for material is to be discouraged. Such broadsides imply that the companies are thoroughly familiar with the needs of the school, that they are sufficiently interested and feel their responsibility enough to search through their many publications for just the material that would be most valuable. Otherwise they might send samples and copies of all bulletins available, but this adds unnecessarily to the cost of such service. As a result some companies simply ignore such communications. All requests for material should be as specific as the needs of the school will permit.

Use school stationery in writing for industrial exhibits. State the use for which this material is intended. Give the company every possible assurance that the material will be preserved and used to the best possible advantage. The misuse and destruction of such exhibits must be discouraged. The various companies are rendering a distinct service by supplying these educational aids. The least any instructor can do is to give the heartiest co-operation. Occasionally certain students and teachers avail themselves of this material for private exploitation, which is most unfortunate. Some companies have been forced to discontinue this valuable service for this very reason, thus depriving other schools of this help because of the selfishness of a few individuals. Even though it may seem pedagogically wise, students should never be permitted to write for such material. Many companies require a statement from the school principal, and other details before supplying industrial material.

It is recognized that this material should not supplant the usual laboratory apparatus. Neither should it curtail the use of other source material which may be secured from the government, school collections and museums. Likewise homemade apparatus, charts and collections should have their usual place in the course.

Obviously in such a compilation no guarantee can be given for the accuracy, infallibility, or completeness of such a list.

Various firms frequently change the nature of their bulletins or exhibits. They may likewise change their attitude in regard to supplying free material. However, this list has been prepared with the greatest possible care and we have every reason to believe that all the companies listed will gladly contribute material for use in science classes.

Abrasives—Pike Manufacturing Co., Pike, N. Y. 50 cents.
Aluminum-Norton Co., Worcester, Mass.
Aluminum Company of America, Chicago, Ill.
Aluminum Goods Manufacturing Co., Manitowoc, Wis.
Ammonia—Herf & Frerichs Co., St. Louis, Mo.
Antiseptics—Zonite Products Co., New York, N. Y.
Merck & Co., 45 Park Place, New York, N. Y.
Johnson & Johnson, New Brunswick, N. J.
Asbestos—Keasby & Mattison, Ambler, Pa.
Powhatan Mining Co., Baltimore, Md.
H. W. Johns-Mansville Co., Milwaukee, Wis.
Asphalt—Barber Asphalt Paving Co., Perth Amboy, N. J.
Barber Asphalt Co., Land Title Bldg., Philadelphia, Pa.
Bakelite—General Bakelite Co., New York, N. Y.
Baking Powder—Rumford Baking Powder Co., Providence, R. I.
Royal Baking Powder Co. 135 Williams St., New York, N. Y.
Batteries—Willard Battery Co., New York, N. Y.
Presto Light Co., Indianapolis, Ind.
Philadelphia Storage Battery Co., Philadelphia, Pa.
Brick—American Brick and Tile Co., Mason City, Ia.
Buttons—Art in Buttons, Rochester, N. Y. 75 cents.
German-American Button Co., Rochester, N. Y. 75 cents.
Carbon—National Carbon Co., New York, N. Y.
Carborundum—Carborundum Co., Niagara Falls, N. Y.
Cement and Concrete—Atlas Portland Cement Co., New York, N. Y.
American Portland Cement Co., Chicago, Ill.
Pacific Portland Cement Co., San Francisco, Calif.
Old Portland Cement Co., San Francisco, Calif.
Russia Cement Co., Gloucester, Mass.
Lehigh Portland Cement Co., Allentown, Pa.
Portland Cement Association, Denver, Col.
Atlas Portland Cement Co., Independence, Kan.
Universal Portland Cement Co., 210 S. La Salle St., Chicago, Ill.
Cereals—Postum Cereal Co., Battle Creek, Mich.
Quaker Oats Co., Chicago, Ill.
Shredded Wheat Biscuit Co., Niagara Falls, N. Y.
Minute Tapioca Co., Orange, N. J.
Kellogg Toasted Corn Flake Co., Battle Creek, Mich.
Albers Bros., San Francisco, Calif.
Armour Grain Co., 208 S. La Salle St., Chicago, Ill.
Pacific Coast Shredded Wheat Co., Oakland, Calif.
Chemist Analyst—J. T. Baker Chemical Co., Phillipsburg, N. J.
Chicory—E. B. Muller & Co., New York, N. Y.
Chlorine and Sodium Hydroxide—The Solvay Co., Detroit, Mich.
Coal and Combustion—Green Engineering Co., East Chicago, Ill.
Coal Products—Barrett Co., New York, N. Y.
The Koppers Co., Pittsburgh, Pa.
Cocoa and Chocolate—Walter Lowney Co., Boston, Mass.
Walter Baker & Co., Milton, Mass.
Huyler's, Irving Place, New York, N. Y.
Hershey Chocolate Co., Hershey, Pa.

Coffee—Chase & Sanborn, 327 N. Wells St., Chicago, Ill.
National Coffee Roaster Association, New York, N. Y.
C. F. Blanke Sales Co., 7th and Clark Ave., St. Louis, Mo. $5.00.
Dwinell-Wright Co., 311 Summer St., Boston, Mass.
Hills Bros., 175 Fremont St., San Francisco, Calif.
Cooking Oils—Southern Cotton Oil Co., Savannah, Ga.
Cooling Troubles—Franklin Motor Car Co., Syracuse, N. Y.
Copper—John A. Roebling Sons Co., Trenton, N. J.
Cork—Armstrong Cork Co., Pittsburgh, Pa. $2.00.
The Nairn Linoleum Co., Kearney, N. J.
Corn Products—Corn Products Co., Battery Place, N. Y.
American Mfg. Ass'n. of Products from Corn, Chicago, Ill.
Cotton—Chamber of Commerce, Manchester, N. H.
Amos King Mfg. Co., Manchester, N. H.
Dyes—E. I. Du Pont de Memour Co., Wilmington, Del.
Electrical—General Electrical Co., Schenectady, N. Y.
Edison Lamp Works, Harrison, N. J.
Electromotive Series—Century Publishing Co., New York, N. Y.
Henry Heil Chemical Co., St. Louis, Mo.
Essential Oils—Magnus, Mabee & Reynard, Inc., New York, N. Y.
Explosives—The Giant Powder Co., San Francisco, Calif.
E. I. Du Pont de Memours Powder Co., Wilmington, Del.
Fertilizers—Ford Motor Co., Detroit, Mich.
Virginia-Carolina Chemical Co., Richmond, Va.
Swift & Co., Chicago, Ill.
Armour & Co., Chicago, Ill.
York Chemical Works, York, Pa.
Western Meat Co., San Francisco, Calif.
Morris Packing Co., Chicago, Ill.
Fiber—Diamond Slate Fibre Co., Bridgeport, Pa.
American Vulcanized Fiber Co., Wilmington, Del.
International Fiber Co., Chicago, Ill. 35 cents.
Fire Extinguishers—The Grinnell Co., Providence, R. I.
Foamite-Childs Corporation, Utica, N. Y.
Flour—Russell-Miller Milling Co., Minneapolis, Minn.
Washburn-Crosby Co., Minneapolis, Minn.
Pillsbury Flour Co., Minneapolis, Minn.
The Sperry Flour Co., Stockton, Calif.
Hecker-Jones-Jewell Milling Co., 40 Corlears St., New York, N. Y.
Igleheart Bros., Evansville, Ind. $1.00.
Northwestern Consolidated Milling Co., Minneapolis, Minn.
Gelatin—Chas. B. Knox Gelatin Co., Johnstown, N. Y.
Glass—Corning Glass Works, Corning, N. Y.
Pittsburgh Plate Glass Co., Pittsburgh, Pa.
Graphite—Joseph Dixon Co., Jersey City, N. J.
Eberhard Faber Co., New York, N. Y. 50 cents.
Acheson Graphite Co., Niagara Falls, N. Y.
Gypsum—U. S. Gypsum Co., Chicago, Ill.
The Gypsum Industries, 844 Rush St., Chicago, Ill.
Ink—Carters Ink Co., 239 First St., Cambridge, Mass.
Iron and Steel—Oliver Iron Mining Co., Hibbing, Minn.
Duriron Co., Dayton, Ohio.
Pittsburgh Steel Co., Pittsburgh, Pa.
Townsite Mine, Ironwood, Mich.
Kelp—Hercules Powder Co., Wilmington, Del.
Lead—Eagle Pitcher Lead Co., Chicago, Ill.
Colwell Lead Co., New York, N. Y.
Limestone—Indiana Granite Co., Chicago, Ill.
Indiana Limestone Quarrymen's Ass'n., Bedford, Ind.

Linen—Klearflax Linen Rug Co., Duluth, Minn. 25 cents.
Linen Thread Co., 96 Franklin St., New York, N. Y.
Ludlow Mfg. Associates, 111 Devonshire St., Boston, Mass.
Magnesia—Magnesia Association of America, Ambler, Pa.
Philip-Casey Co., Cincinnati, Ohio.
Ehret Magnesia Mfg. Co., Forge, Pa.
The Franklin Mfg. Co., Franklin, Pa.
Keasby-Mattison Co., Ambler, Pa.
Matches—The General Match Co., Cincinnati, Ohio.
The Michigan Match Co., Saginaw, Mich.
Meat—Wilson & Co., Chicago, Ill.
Armour & Co., Chicago, Ill.
Morris & Co., Chicago, Ill.
Swift & Co., Chicago, Ill.
Medicines—The Mentholatum Co., Wichita, Kan.
American Medical Association, Chicago, Ill.
Milk—National Dairy Council, Chicago, Ill.
Borden's Condensed Milk Co., 110 Hudson St., New York, N. Y.
Horlick's Malted Milk Co., Racine, Wis.
Nickel—International Nickel Co., New York, N. Y.
Nitrocellulose—Hercules Powder Co., New York, N. Y.
Nitrogen—The Nitragin Co., Inc., Milwaukee, Wis.
Wm. S. Meyers, Chilean Nitrate Comm., New York, N. Y.
Paints and Varnish—Berry Bros., Detroit, Mich.
Sherman-Williams Co., Cleveland, Ohio.
Paraffin Paint Co., San Francisco, Calif.
Paint Mfg. Ass'n. of the U. S., 636 The Bourse, Philadelphia, Pa.
Paper—Hammermill Paper Co., Erie, Pa.
The Champion Coated Paper Co., New York, N. Y.
Hampshire Paper Co., South Hadley Falls, Mass.
Itasca Paper Co., Grand Rapids, Minn.
St. Paul Pioneer Press, St. Paul, Minn.
Strathmore Paper Co., Mittineague, Mass.
American Writing Paper Co., Holyoke, Mass.
Peanut Butter—Beechnut Packing Co., Canajohorie, N. Y.
Pens—The Esterbrook Steel Pen Mfg. Co., Camden, N. J.
C. Howard Hunt Pen Co., Camden, N. J.
Spencerian Steel Pen Co., 349 Broadway, New York, N. Y.
L. E. Waterman Co., 191 Broadway, New York, N. Y.
Perfumes—E. R. Squibb & Sons, Brooklyn, N. Y.
Petroleum—Standard Oil Co., Chicago, Ill.
New York Lubricating Oil Co., New York, N. Y.
Tidewater Oil Co., San Francisco, Calif.
Texas Co., 17 Battery Place, New York, N. Y.
Vacuum Oil Co., 61 Broadway, New York, N. Y.
Sinclair Refining Co., 111 W. Washington St., Chicago, Ill.
Photography—Eastman Kodak Co., Rochester, N. Y.
Porcelain—Coors Co., Golden, Col.
Williams, Brown & Earle, 918 Chestnut St., Philadelphia, Pa.
Potash—German Kali Co., Chicago, Ill.
Potash Importing Corp. of America, 81 Fulton St., New York, N. Y.
Rubber—Chemical Rubber Co., Cleveland, Ohio.
B. F. Goodrich Co., Akron, Ohio.
Hood Rubber Co., Watertown, Mass. 60 cents.
Firestone Tire and Rubber Co., Akron, Ohio.
U. S. Rubber Co., 1790 Broadway, New York, N. Y.
Salt—Worcester Salt Co., New York, N. Y.
Diamond Crystal Salt Co., St. Clair, Mich.
Seeds—Northrup King & Co., Minneapolis, Minn.

Shears—W. H. Compton Shears Co., Newark, N. J.
J. Wiss & Sons Co., Newark, N. J.
Shoes—W. L. Douglas Shoe Co., Brockton, Mass.
United Shoe Machinery Corp., Boston, Mass.
Silk—Corticelli Silk Co., Lawrence, Mass. $2.00 and $.50.
Cheney Silk Co., New York, N. Y.
T. A. Kelleher, Box 82, Washington, D. C. $1.75.
Belding Bros. & Co., Chicago, Ill.
Cheney Bros., South Manchester, Conn.
Hemingway Silks, Watertown, N. Y.
Brainerd & Armstrong Co., New London, Conn.
H. K. H. Silk Co., 120 E. 16th St., New York, N. Y.
Silks, Artificial—The Viscose Co., New York, N. Y.
Du Pont Fibre Silk Co., Niagara Falls, N. Y.
Industrial Wood Fibre Co., Cleveland, Ohio.
Tubize Artificial Silk Co., Hopewell, Va.
Slate—National Slate Association, Philadelphia, Pa.
Soap—Java Cocoanut Oil Co., Kansas City, Mo.
Kirkman Soap Co., New York, N. Y.
Lever Brothers, Toronto, Ontario, Canada.
Procter and Gamble, Cincinnati, Ohio.
Larkin Co., Buffalo, N. Y.
Soda—Church and Dwight Co., 27 Cedar St., New York, N. Y.
Wm. S. Meyers, Chilean Nitrate Committee, New York, N. Y.
Soils—Oliver Chilled Plow Works, San Francisco, Calif.
Bureau of Soils, U. S. Dept. of Ag., Washington, D. C. $1.75.
Spices—D. & L. Slade Co., Boston, Mass.
McCormick and Co., Baltimore, Md.
Spoons—American Silver Co., Chicago, Ill.
Steel—Multi Metal Co., New York, N. Y.
Fansteel Products Co., North Chicago, Ill.
Titanium Alloy Mfg. Co., Niagara Falls, N. Y.
Illinois Steel Co., South Chicago, Ill.
United Alloy Steel Corporation, Canton, Ohio.
Sugar—Warner Sugar Refining Co., New York, N. Y.
American Sugar Refining Co., New York, N. Y.
California-Hawaiian Sugar Refining Co., San Francisco, Calif.
Talc—Eastern Talc Co., 45 Milk St., Boston, Mass.
Tea—C. F. Blanke Sales Co., 7th and Clark Ave., St. Louis, Mo. $5.00.
Thermit—Metal and Thermit Corp., 120 Broadway, New York, N. Y.
Thimbles—Scovill Manufacturing Co., 280 Broadway, New York, N. Y.
Thread—Spool Cotton Co., New York, N. Y.
Vinegar—H. J. Heinz Co., 1062 Main St., Pittsburgh, Pa.
Watches—Waltham Watch Co., Waltham, Mass.
Elgin National Watch Co., Elgin, Ill.
White Lead—Carter White Lead Co., Chicago, Ill., or Omaha, Neb.
Wood Products—Diamond Fiber Co., Bridgeport, Pa.
Southern Cypress Association, New Orleans, La.
C. H. White Bros., San Francisco, Calif.
White Bros., 5th and Brannon Sts., San Francisco, Calif.
C. S. Johnson & Son, Racine, Wis.
Wool and Yarn—Amos Kiag Mfg. Co., Manchester, N. H.
National Wool Warehouse and Storage Co., Chicago, Ill.
North Star Woolen Mills Co., Minneapolis, Minn.
American Woolen Co., Boston, Mass.
S. B. and B. W. Tleisher, Inc., Philadelphia, Pa.
Yeast—Fleischmann Co., New York, N. Y.
Northwestern Yeast Co., 1750 N. Ashland Ave., Chicago, Ill.
Zinc—New Jersey Zinc Co., 160 Front St., New York, N. Y.

Acquiring Some Knowledge of Cultivated Plants

N. M. Grier, State Teachers College, West Chester, Pa.

Some knowledge of the identity of the more commonly cultivated plants should be valuable to Geography, Nature Study, and Biology teachers, as well as to their pupils. Such information is always best obtained through garden and conservatory trips under the leadership of some well-informed person, and then followed up by a comparison of the collected specimens with the descriptive material in Gray's "Field, Forest and Garden Botany" or Bailey's "Manual of Cultivated Plants." Conservatories are very useful for this purpose since their exhibition plants are generally labelled. On the other hand, the conservatory usually contains so many plants not commonly seen in houses or gardens, that the novice is apt to be swamped by the abundance of species to obliteration of those plants he might more usually encounter. Again, it is somewhat difficult at times to obtain from gardens and conservatories specimens which the student may examine at his leisure.

Former students of mine in Systematic Botany have reported the following procedure useful in acquiring some knowledge of cultivated plants, either as a preliminary or following up activity, or when the facilities indicated are absent. A collection of floral catalogues is made, and from them are clipped the illustrations of plants, exclusive, of course, of the varieties of well-known genera such as *Rosa*, *Gladiolus*, etc. A large number of different catalogues is necessary because many firms feature special groups of plants, and what may not be illustrated in one catalogue may be found so in another. A list of nurserymen furnishing catalogues is given below, and here I may state that these firms are as a rule very accommodating to teachers interested for any reason in their merchandise.

If only the names of the plants are desired, the clipped illustrations may next be pasted in a scrapbook in any order, and observed at leisure. If a more detailed knowledge is to be conveniently sought the illustrations should be grouped by the plant families they represent. This information can be obtained by reference to the indexes of the manuals indicated,

or more preferably to the Bailey "Cyclopedia of Horticulture." At this time the scientific and common names of the particular plant may be checked with some accuracy. Thereafter the illustrations may be grouped by the plant family they represent and placed in old envelopes—old ones will do—and pasted in the scrapbook under the title of the particular plant family. Beneath each illustration may be given the appropriate reference to the Cyclopedia, for a time when additional information is desired of the particular species for any purpose. Teachers will find such a scrapbook useful in their class work, while advanced students in Botany will find them to be a convenient method of adding to their knowledge of Systematic Botany.

SOURCES OF FLORAL CATALOGUES

Hicks Nurseries, Westbury, L. I., N. Y.
Heller Bros. Co., New Castle, Ind.
W. Atlee Burpee, Philadelphia, Pa.
A. E. Kunderd, Goshen, Ind.
Stokes Seed Farms, Morristown, N. J.
John A. Saltzer Seed Co., La Crosse, Wis.
Charles H. Totty Co., Madison, N. J.
John S. Armstrong, Ontario, Cal.
Hart and Vicks, Rochester, N. Y.
Geo. L. Stillman, Westerly, R. I.
Wayside Gardens Co., Mentor, Ohio.
Howard U. Smith, Los Angeles, Cal.
Peter Henderson Co., Cortlandt St., N. Y.
Stumpf and Walter Co., Barclay St., N. Y. City, N. Y.
Conard and Jones Co., West Grove, Pa.
Alexander Co. Nurseries, McClure, Ill.
Tegeloar Bros., 1153 Broadway, N. Y.
Morris Nursery Co., 1133 Broadway, N. Y.
John Sheepers and Co., 2 Stone St., New York City.
A. W. Smith Co., Keenan Bldg., Pittsburgh, Pa.
Storrs and Harrison Co., Painesville, O.
D. M. Ferry Co., Detroit, Mich.
Beckert's Seed Store, Pittsburg, N. S., Pa.
Sutton and Sons, Reading, England.
R. and J. Farquhar, Boston, Mass.
Henry L. Dreer, Philadelphia, Pa.
Barnett Bros., 92 Chambers St., N. Y.

Joseph Breck and Sons, 51 N. Market St., Boston.
J. M. Thorburn, 53 Barclay St., N. Y. City.
Bay State Nurseries, N. Abington, Mass.
A. N. Pierson, Inc., Cromwell, Conn.
J. T. Lovett, Little Silver, Conn.
Elliott Nurseries, Magee Bldg., Pittsburg, Pa.
W. M. Hunt and Co., 148 Chambers St., N. Y.
E. T. Brainfield, Garden City, N. Y.
A. T. Buddington, 128 Chambers St., New York City.
Carl Purdy, Okiah, Cal.
L. G. Farmer, Pulaski, N. Y.
I. N. Simon, 436-38 Market St., Philadelphia, Pa.
W. Elliott and Sons, 42 Vesey St., New York City, N. Y.
Edward Gillett, Southwick, Mass.
T. J. Bromwell, Eagle Rock, Cal.
Palisade Nurseries, Sparkell, N. Y.
Andorra Nurseries, Chestnut Hill, Philadelphia, Pa.
B. H. Farr, Wyomissing Nurseries, Wyomissing, Pa.

The Biography of Scientists for Teachers in Training

WILLIAM GOULD VINAL
Cleveland School of Education

A discovery. Some second semester girls are keeping company with some interesting men. The reporter thought that he had unearthed a scandal but the girls declare that they are getting standards of measurement for teaching.

Abe Lincoln is my man, said one co-ed shyly. Why he hiked 18 miles to go to school. He had to go through woods where there were bear, deer, coon, and wildcats. As soon as he started he was in a school,—a school of the woods. Abe learned the secrets of the sugar maple, the sycamore, and the Jack oak. He knew the ways of the catfish on Little Pigeon Creek. He had to match wits with the farm animals. He knew what it meant to make a fence hog-tight, horse-high, and ox-strong. One day he walked 34 miles to hear a lawyer make a speech. The champion walker in our class takes fifteen minutes to get to the School of Education and Penelope B. "liked to died" the other day. She got on the Wade Park car by mistake and did not have another car check.

"Tom Edison gave me an idea," said A. B. His teacher called him a dunce and sent a note home saying "That it was no use." "Just think," she continued, "he succeeded in spite of his teacher." "Four o'clock one morning," she continued, "Edison came home with Faraday's complete works on electricity. He was so fired with what he read that he ran about a mile to get breakfast that he might get back to his reading. I am going to be mighty cautious about 'assigned readings.' I am going to be broadminded enough to let each pupil show me his interest instead of apportioning my own interests."

"Speaking of Faraday," and Miss K. smiled. "He belonged to a club of boys who met in an attic and corrected each others papers. I was president of a Literary Club in high school and all we did was to have parties. We did have a play once to get money to buy more eats but we never studied literature. There must be two kinds of clubs, 'The Self-starters' and those you 'Crank up.' Hope I can get the right kind of mixture to have some 'Self-starters.' Yes, I think teaching is an art."

"Of course Michael Pupin is alive," chuckled Miss R. as though the query was sort of silly. "Do you think that all great people are dead?" Then thoughtfully, "Yes, Lincoln lives, but Pupin is a real, live professor at Columbia University. And that reminds me that Michael used to read about Lincoln, Franklin, and Harriet Beecher Stowe when he was a shepherd boy in the Serbian hills. When he landed at Ellis Island the immigration authorities asked him if he knew anyone in America. He said that he knew Lincoln, Franklin, and Harriet Beecher Stowe. And they let him in. The inspiration that Pupin got from the lives of these Americans helped to carry him to his high attainments. You would enjoy reading his autobiography 'From Immigrant to Inventor.'

"When Michael landed in New York he had 6 cents in stamps. He squandered it for a piece of prune pie to find that it was full of pits. He says that if he had a million it would have made no difference. He had to learn by experience. He must have gotten a great deal of encouragement from picturing his friend Franklin walking into Philadelphia with a loaf of bread under each arm. Sometimes I wonder if poverty is not the first step to success. At least it did not

prevent many men from becoming great. And Franklin left school when he was ten. Peggy H. is trying to discover what made Franklin successful. She feels that perhaps the schools lack some vital things that they ought to have."

"Boys and girls have to become great by their own efforts. No one can eat for them or grow for them. No one can become great for them. And they grow best when directed in the line of their own in terests. They wanted to make a printer out of Franklin, a physician out of Galileo, a clergyman out of Darwin, and a farmer out of Newton. Some parents and teachers in caring for their children are like 'setting hens' trying to mother ducklings. The hired man on Newton's farm, on driving to market used to leave the boy Newton by the roadside to study and he would then get him on the way back. Some hired men are teachers and some teachers would make better hired men. This teaching game carries a responsibility as well as art."

"What did you learn from this biographical study, Miss Smith?" I ventured to query. Her answer came back quickly and to the point. "I studied Pasteur. I was surprised that he got mediocre grades in Chemistry. It seems to me that the teacher must have been grading him on his interest and ability as a parrot rather than chemistry. I had a phonograph for a teacher once myself and know how Pasteur must have rebelled. It has given me a new viewpoint as to grading. And I am not at all sure that grades are a matter of life and death."

And when anyone is interested it is surprising to find how little help is needed. Alexander Graham Bell told Joseph Henry that he was not able to do some things with the telephone that he wanted to do as he did not know enough about electricity. Henry said: "Get it." These two words were stimulating enough. Bell did "get it." It does seem as though it would be easier to "GUIDE" than to govern the individual. Teacher and pupil would both be working toward the same end instead of against each other.

Galileo's favorite pastime was making original toys. Agassiz played in a backyard pool, a natural aquarium. James Watt drew pictures on the hearth. Pasteur went fishing. An interesting thing to do—perhaps a profitable thing to do, if we are the right kind of a teacher, is to take a census of child

pleasures, the things that the children in our room are enjoying. And, dear guide, handle this delicate thread of information with "fear and trembling." Thereon may rest the destiny of a great person.

Darwin mentions that the shape of his nose almost determined the turning point of his life. He was a candidate for a trip on the Beagle which was to sail around the world. The captain did not think that young Darwin's nose showed determination. After many misgivings he accepted the boy and paved the way for a great naturalist. It is such decrees that teachers are called upon daily to decide.

The Place of Science in Education

There has just been published a report of the committee of the American Association for the Advancement of Science on "The Place of Science in Education."

This report is organized under seven headings, as follows, and the summarizing sentence is given for some of them:

I. The Committee's Understanding of its Functions.

II. The Search for Enduring Facts and the Growth of Confidence in the Guidance of Scientific Truth. Science instruction both in school and out needs better organization, more effective cooperation to make even the health knowledge now available function more completely in the lives of people generally.

III. Obligations of Science Knowledge. Science, not to be discredited, must devise effective ways and means of developing, in its devotees first and in the whole people ultimately, a sense of moral obligation that will prevent the newly acquired knowledge and method of science serving base ends.

IV. The Science Subjects in Educational Programs. The hopeful element is that the stereotyped science courses of the college are being replaced in the earlier years at least by new types, tentative at present but frankly experimental, looking toward a more satisfactory college science sequence. The whole problem needs careful study.

V. Summaries of Types of Specific Studies Relating to the Educational Uses of Science. The above represent but a beginning in the application of the objective scientific method to the problems of science teaching. Such investigations must be multipled and verified by those truly interested in the scientific solution of such questions.

VI. Those Who Teach Science. A more thorough-going preparation in the fundamentals of science is needed by all who aspire to teach it.

VII. Those who have Developed Science. Science as method is quite as important as science subject matter and should receive much attention in science instruction.

The committee offers the following recommendations:

(a) That some organization of national scope, such as the United States Bureau of Education, or the Research Division of the National Education Association, be asked by this committee to undertake a comprehensive and intensive study of the situations, tendencies and needs of science instruction in educational systems.

(b) That the services of a field secretary be secured, to work with existing agencies, to distribute information on research in science education, to stimulate further research, to operate as a sort of clearing-house agent and to continue the organizing of new groups of science teachers, writers for popularization of science, etc. This field secretary should work under the guidance of the Committee on the Place of Science in Education, or under the guidance of a national council of science teachers as soon as such a council is formed.

(c) That a national council of science teachers be organized to advance science teaching, to increase public appreciation of science and to secure for science teachers increased facilities and a wider usefulness. The services of a field secretary would be very useful in the organization of such a council.

A copy of the full report will be mailed on request sent to Elliot R. Downing, School of Education, University of Chicago, Chicago, Illinois.

Science Courses in Summer Schools

CLEVELAND SCHOOL OF EDUCATION—Senior Teachers College—June 18-July 27.

General Biology—Introductory Course in the Principles of Biology. Ellis C. Persing.

Hygiene—Personal Hygiene—Cause and Prevention of Disease. Mr. Ackerman.

Heredity and Eugenics—Introduction to Study of Heredity and Variation. Mr. Hersh.

Local Flora—Summer Wild Flowers—Practice with manual in the field. Mr. Persing.

General Science—Physical Science—Gives scientific background to questions children ask about their physical environment. Mr. Persing.

Nature Guiding—Located at Hudson, Ohio, on a five hundred acre tract of farm and forest land. To train councillors, guides, playground leaders, and campfire naturalists. Courses are also offered at the University in Cleveland, which will give credit in nature study. William Vinal, Director.

CORNELL UNIVERSITY, Ithaca, New York. June 30-August 10.

General Nature Study—Field and laboratory observations. Prof. Palmer.

The Nature-Study Movement and Its Makers—History and present status of Nature-Study. Professor Palmer.

Science in Rural Secondary Schools—Functions of high school sciences and methods of teaching. Professor Palmer.

HAMPTON INSTITUTE. June 13-July 20.

General Science, three hours daily. Teacher courses—Subject-matter, methods, and apparatus building. O. E. Underhill.

HAMPTON INSTITUTE. July 23-August 29.

Household Chemistry. Subject matter and methods. O. E. Underhill.

Household Physics. Subject matter and methods. O. E. Underhill.

HARVARD UNIVERSITY. July 2-August 11.

Principles and Organization of Science teaching in secondary schools. Aims, methods, equipment, texts. N. Henry Black.

INDIANA STATE NORMAL SCHOOL, Terre Haute. May 7-June 9 and July 23-August 25.

Elementary Science. Clarence M. Priutt.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY. July 2-July 31.

Methods of Teaching General Science. Deals with Junior High and first year of Senior High Schools. Joseph R. Lunt.

General Science Laboratory—practical courses to help teachers in experiment work. Joseph R. Lunt.

Methods of Teaching Physics in High Schools. Questions in the major field of physics. Fred R. Miller.

Methods of Teaching Chemistry in High Schools. Roy K. McAlpine.

STATE TEACHERS COLLEGE, Mankato, Minnesota. June 18-July 27.

Nature Study—general survey—field trips—teaching problems. Mr. Trafton.

UNIVERSITY OF CHICAGO. June 18-August 31.

Supervision of science teaching. For superintendents, supervisors, and critic teachers. Professor Beauchamp.

Introduction to the Teaching of Science. Mr. Frank.

The Teaching of General Science. Mr. Anibal.

Technique of Science Teaching. For experienced teachers and heads of departments. Professor Downing.

The Science Curriculum. For experienced teachers and heads of departments. Professor Downing.

UNIVERSITY OF WISCONSIN. June 25-August 5.

Investigations in the Teaching of Science. Curriculum studies in Science, Grades 1-12. Mr. Davis.

The Teaching of General Science. Organization and development of courses. Mr. Davis.

TEACHERS COLLEGE, COLUMBIA UNIVERSITY, July 9-Aug. 17.

Teaching and supervision of science. For junior and senior high schools. S. R. Powers.

Biological foundations of education. Facts, principles, and interpretations of modern biology. O. W. Caldwell.

Course of study construction in science. For elementary and secondary schools. S. R. Powers.

Teaching general science in secondary schools. Content, methods, field work, textbooks, demonstrations, laboratory work, equipment and reference readings of the introductory course in high school science. E. R. Glenn.

Demonstration class in junior high school science. There will be three demonstration lessons a week in a class of seventh-grade children. A. I. Lockhart.

Demonstration class in general science. A class in general science for the junior high school is conducted in the Demonstration School. H. J. Arnold.

Teaching biological sciences in secondary schools. A general view of the problems confronting teachers of biology in the high school. W. G. Camp.

Teaching chemistry in secondary schools. Modern theories and practice of teaching chemistry in secondary schools. A. I. Lockhart.

Teaching physics in secondary schools. Subject matter, textbooks, laboratory manuals, demonstrations, excursions, tests, equipment, and reference readings of the high school physics course. E. R. Glenn.

Field studies in science. W. G. Camp.

Organization of science in elementary schools. For teachers and supervisors of the science of the first six grades, and for normal school instructors who are preparing to give courses for teachers of elementary school science. G. S. Craig.

Illustrative lessons in science for the elementary school. Presents recent developments in the methods of instruction in elementary science. G. S. Craig.

The New Books

New Laboratory Problems in Civic Biology—1927—GeorgeW. Hunter—286 pages—Illustrated—loose leaf form—$.96—American Book Company.

This excellent manual contains 136 exercises, which are primarily to accompany the author's text, "New Civic Biology." The exercises cover the environment of living things, the relations of plants and animals, the building material of living things, relation of roots and soil, how a plant makes and uses food, simplest organisms, the human machine, dietaries, food adulteration, preparation of food for the body, the blood, getting rid of body waste, body control, habits, reproduction, disease, improving the environment, economic importance of animals, how the human race may be improved. There is a long list of reference books for additional study.

Teachers Manual to Accompany "New Civic Biology"—1927—112 pages—$.60—American Book Company.

This little book will bring to the inexperienced teacher some very helpful suggestions about how to organize the work, methods of teaching, sources of material, and seasonal topics.

Lands and People: Hawaii and the Philippines—1928—Frank F. Bunker—207 pages—136 illustrations—12 maps—J. B. Lippincott Co.

We have found this book a delight, and while it is simple enough for pupils in the junior high school, we would set no upper limit for its use. Its five chapters treat (1) native life in Polynesia, (2) the coming of the white man to Hawaii, (3) Hawaii today, (4) land and people of the Philippines, (5) discovery and conquest of the Philippines. The book is of the geography reader type, but has some good science reference material in it.

Our Environment: Its Relation to Us—1928—Harry A. Carpenter and George C. Wood—297 pages—illustrated—Allyn & Bacon.

This is book I of a series of three books in science for the junior high school. It contains the elementary science problems adapted to the capacity of children in the seventh grade. Classroom demonstrations form the basis for much of the matter discussed. The main discussions are water, rocks and soil, air, fire, trees. It is planned and written in the same attractive style as book III which has already been published. Each chapter has "key sentences," "thought questions" and "special problems."

Meteorology—1928—David Brunt—112 pages—19 illustrations—$1.00—Oxford University Press, Am. Br., N. Y. C.

This book gives briefly a discussion of the physical principles underlying weather. It begins with an historical treatment, and then takes up the atmosphere, standard meteorological observation, general circulation of the atmosphere, solar radiation, temperature, weather map, cyclonic depressions, thunder storms.

New Introduction to Science—1928—Bertha M. Clark—480 pages—illustrated—American Book Company.

A careful revision of the author's "Introduction of Science" has resulted in this up-to-date volume which treats the fundamental general science units in an interesting way.

The subject matter includes: Heat and Fire; Food and Water; Clothing and Fabrics; Light and Illumination; Health; Factors of Our Environment; How the Work of the World is Accomplished; Electricity; Life, How it Continues and Varies; Learning to Know the Heavens. Numerous problems are introduced to stimulate thought and to show the practical nature of science. Each chapter ends with directions for organized review.

Fundamentals of Modern Chemistry—1928—H. R. Smith and Harry M. Mess—266 pages—51 illustrations—Henry Holt and Company.

This book aims to give particular emphasis on fundamentals, leaving out unimportant details which so often bewilder the young student. The modern knowledge of atomic structure and valence is simply explained. Questions following each unit serve for self-testing. Twenty-five pages of equations and review questions at the back of the book are useful in a general review of the subject.

Foundations of the Universe—1925—M. Luckiesh—245 pages—17 illustrations—$3.00—D. Van Nostrand Company.

The foundation building materials of which the universe is constructed is the theme of this book. A reading of it gives us a better appreciation of the harmony and unity of the various details involved in building a physical world of such magnitude as ours. Some of the topics treated give an idea of the subject matter: Men, Atoms and Stars; Matter and Motion; The Realm of the Molecule; Light; Space; The Epoch of Einstein; Matter; The Electron Theory; Elements; Inside the Atom; Quantum Theory; Fateful Unknown; The Growth of Knowledge.

A very helpful book for the science teacher and advanced student.

Elementary Bacteriology—1928—Joseph E. Greaves and Ethelyn O. Greaves—560 pages—129 illustrations—$3.50—W. W. Saunders Company.

This book is a text for elementary courses in bacteriology. It is a book that every general science teacher should read with care, since just such a background of knowledge is needed to teach well, the little bacteriology which should be a part of every general science course.

The book is also a valuable reference for elementary science pupils. It covers the practical aspect of bacteriology as we meet it in daily life.

Fundamentals in Visual Instruction—1927—William H. Johnson—104 pages—The Educational Screen, Incorporated, Chicago.

The development of visual aids to education is changing our teaching. It is important to keep informed in this field. This book will be of assistance not only to science teachers but to teachers of other

subjects. Part I discusses the principles and experiments in visual instruction. Part II shows what visual aids may be used in the various subjects as: Geography, History, Music, Art, Science, Reading, Writing, and Arithmetic. Part III describes equipment for visual instruction.

Educational Biology — 1928 — William H. Atwood and Elwood D. Heiss—469 pages—259 illustrations—$2.75—Blakiston's Son and Company.

This is a subject matter course in biology, intended to give those who are in training to teach, a background which will help in understanding human behavior. It will, therefore, be of assistance in guiding them in the application of modern pedagogy.

The main divisions or units of study are: 1 Life types. 2. The science of biology. 3. A series of life types. 4. Classification of plants and animals. 5. Food and its relation to life. 6. The properties of life. 7. Variation and heredity. 8. The improvement of life. 9. The behavior of living things. 10. Human diseases and their control. 11. Biological evolution. 12. The ascent of man.

American Fruits — 1927 — Samuel Fraser — XV + 892 pages — 173 illustrations—$4.75—Orange Judd Publishing Company, Inc.

"American Fruits" is both a practical fruit-growing guide and a text for the student interested in fruit growing. It is a comprehensive work covering soil, drainage, climate, tools, fertilizers, spraying, pruning, marketing and many other practical problems. It is not too technical for high school use. It is the best book of the kind we have seen on the subject. Whether you are interested in growing oranges in Florida, apples in New York, figs in California, or olives in Arizona, you will find here the practical facts about the industry and the methods of procedure to produce a crop.

First Course in Botany—1928—R. J. Pool and A. T. Evans—414 pages—219 illustrations—$1.64—Ginn and Company.

This volume presents an up-to-date treatment of plant life for those who prefer to spend a greater length of time upon botany than is usually given in the General Biology course. It covers cells and organs, leaves, roots, flowers and their work, seeds, environment, classes, and types of classes, forestry, breeding, and plant disease.

A Laboratory Manual for First Course in Botany — 1928 — A. T. Evans—155 pages—50 illustrations—$.72—Ginn and Company.

This manual contains 111 experiments which form a suggestive outline of work to follow with the author's "A First Course in Botany."

New Biology — 1924 — W. M. Smallwood, I. L. Reveley and G. A. Bailey—760 pages—416 illustrations—Allyn and Bacon.

This biology "offers a unit course dealing with the function of living things" and is divided into five parts:

1. The idea of biology.
2. Application of biological principles to animal life.
3. Application of the biological principles to the human body.
4. Application of the biological principles to plants.
5. General biology.

Practical Amateur Photography—1927—William S. Davis—245 pages —illustrated—$2.00—Little, Brown and Company, Boston.

The author describes in proper sequence each step in the evolution of a finished photograph. An interesting account of the early beginning of photography adds to the value of the book for use as a science class reference book. Although the theoretical ground work is given the language is not technical but can easily be understood by the average general science student.

Elementary Practical Mechanics—1927—J. M. Jameson—320 pages—238 illustrations—$2.25—J. Wiley and Sons.

This is a third edition. Not only has much of the text been rewritten but much new material has been added. It covers these subjects: Force; Motion and moments; Composition and resolution of velocities and forces; Equilibrium; Parallel and non-concurrent forces; Commercial appliances; Structures; Forces producing motion, work, power and energy; Friction; Machines; Elasticity and strength of materials; Mechanics of fluids.

Elements of Machine Design—1928—J. D. Hoffman and L. A. Scipio—327 pages—200 illustrations—$3.80—Ginn and Company.

The authors here attempt to give a maximum of information in a minimum of time. A knowledge of calculus and mechanics is rather essential to this course. The first division of this book lays down the fundamental principles of machine design and the second is devoted to design applications.

Tinkering with Tools—1926—Henry H. Saylor—248 pages—illustrated—$2.00—Little, Brown and Company.

The description of the use and care of common tools given in this book will be of much assistance to the science teacher who likes to make things. It is equally interesting and helpful to the man whose hobby is a home workshop, or to one who enjoys being the handy man around the house. Besides a treatment of carpenter's tools and their uses, we find chapters on electricians' tools, fuses, switches, electric materials and sockets, plumbing, masonry, and finishing. A final chapter on "odd jobs" gives suggestions for repairing window cords, shingling, glazing, soldering, plastering, and refinishing old furniture.

Forests and Water in the Light of Scientific Investigation—Raphael Zon—1927—106 pages—$.20—paper covers—United States Printing Office.

This is a report of the direct influence of the forests upon water in streams, and brings together the well-established scientific facts on this subject. It gives the influence of forests on stream flow determined I. by the physical method and II. by the hydrometic method.

A Course in General Biology—A Laboratory Manual—1918—Henry S. Pratt—178 pages—$1.48—Ginn and Company.

The purpose of this manual is to offer an opportunity to study animals and plants at first hand. The following studies will suggest the scope of this work: frog, wasp, beetle, fly, grass-hopper, caterpillar, centiped, spider, lobster, sow bug, daphnid, earth worm, sand worm, fresh water clam, oyster, water snail, starfish, polyp, meausa, sponge, infusoria, rhizopod, theh cell, algae, yeast, bacteria, mole, fern, flowering plant.

Everyday Electricity—1924—Herbert T. Wade—299 pages—illustrated—$2.00—Little, Brown and Company.

This book gives a popular account of our common electrical devices in greater detail than the classroom text does. It is in a simple non-technical language and so makes a good supplementary source book in electricity for elementary students. It covers static electricity, magnetism, generators, batteries, electrical units, induction, D. C. & A. C., the telegraph and telephone, lighting, distribution of electricity, heating, waves, X-rays, lightning.

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Elementary Principles of Chemistry, Revised Edition—1926—Brownlee, Fuller, Hancock, Sohon, and Whitsit—616 pages—240 illustrations—Allyn and Bacon.

The teacher who wishes to use the electron theory constantly in his chemistry course will enjoy this book because the revision was undertaken primarily to include the electron theory and to make use of it in much of the theoretical work. The other matter is of the same high quality as in the former edition.

How to Make Linoleum Blocks—Curtiss Sprague—64 pages—illustrations—$1—Bridgman Publishers, Pelham, New York.

The fascinating work of making linoleum blocks from which to print an original design is clearly and fully described. A number of well-known artist's illustrations show the possibility of this art and gives the students a worthy incentive for his efforts.

Introductory Text Book of Electrical Engineering—1928—J. B. Benton—347 pages—299 illustrations—$3.60—Ginn and Company.

Students in elementary electrical engineering who use the text need some knowledge of college physics and elementary calculus. It is suitable as a short course in some of the engineering departments and as an introductory course for those who will continue in electrical engineering.

Loyola Educational Index—February, 1928—5 issues a year—cumulative in December—$15—Loyola Educational Index, 3441 North Ashland Avenue, Chicago.

The first number of what promises to be a valuable aid to the educator has appeared. There are ninetey-seven educational journals listed. All articles dealing with theory and practice in teaching will be catalogued in the index. Content material is not included. Articles are listed both under subject matter titles and authors.

Nature Stories for the Children. Two volumes—1. *Autumn*—1926, 2. *Spring*—1927—Eva L. Gordon and Jenny Hall—illustrated in colors 90c each—Mentzer Bush and Company.

These two books are suitable for second-grade children. They are attractive and very well written. Children will enjoy them. They take up flowers, trees, seeds, gardens, birds, insects and other forms of animal life.

Nature Study and Health Education—4th year—1927—131 pages. 5th year—1926—192 pages. 6th year—1927—224 pages—all illustrated—paper or cloth covers. 70c each—Alice J. Patterson, McKnight and McKnight, Normal, Illinois.

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Note Book in Science Study and Health Education—4th year—80 pages—40c: 5th year—78 pages—40c: 6th year—96 pages—50c—Alice J. Patterson—McKnight and McKnight.

Each of these note books is designed to be used with the author's text of the same year. The sets have blank spaces for the pupils to write in observations or answers to the printed questions. Many references refer the pupil to the place in the text, which should be read in order to write up some suggested topic.

Our National Parks—Book I—Mary A Rolfe—320 pages—illustrated—1927—Benjamin H. Sanborn and Co.

This is a particularly attractive volume. It describes the travels of two families in their visits to the various National Parks. The stories have much material drawn from history and legend woven into the experiences of the families. Adventures, sportsmanship, and mountaineering are mingled with the descriptions of natural beauty and awe-inspiring creations of nature. Wild life is not omitted. The book is not only interesting, but it is filled with valuable information.

Practical Problem Projects—1927—F. W. Raweliffe—130 pages—illustrated—paper covers—F. E. Compton and Co., Chicago.

This has projects for grades one to nine. The projects cover a wide range of topics, but many of them are in the field of science. We find in grade one, "The Importance of Water"; grade 2, "Our Hero of Peace The Fireman"; grade 4, "The Story of a Loaf of Bread" and "The Story of Sugar"; grade 5, "The Lumber Industry," "The Story of a Cotton Dress" and "Building a House of Concrete"; grade 6, "From Poplar to Paper"; grade 7, "The Story of Stone" and "How Nature Disperses Seeds"; grade 8, "Iron and Steel" and "Black Diamonds that Do the World's Work"; grade 9, "Electricity" and Weather." Each project has helpful suggestions and many references to Compton's Pictured Encyclopedia where additional information will be found.

Elementary Science Readers—1927—Book I (184 pages) and Book II (288 pages)—E. George Paine, Henry R. Burrows, Loius J. Schmerber—illustrated—Benjamin H. Sanborn and Co.

These books deal with animal and plant life. They are planned to serve as reading books, as well as science books. Book I is for grades three and four and consists of a variety of stories which are teeming with interesting things from our natural world. Book II is somewhat more advanced, but possesses the same plan as book I. Each unit is checked by a few questions which help to clinch the important things in the unit.

How to Make a Cat Boat—12 pages—15c—*How to Make Crystalline Lamp Shades*—8 pages—15c—Practical Arts Publishing Co., Elizabeth, N. J.

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ASTRONOMY

Four Old Astronomical Observatory Buildings. Sci. Mo., p. 372, Apr. 1928.

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The Atom as a Source of Energy. Sci. Mo., p. 140, Feb. 1928.

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"R-100," Latest British Air Liner. Sci. Amer., 138:335, Apr. 1928.

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An Iceless Refrigerator Car. Lit. Dig., 96:13:22, March 31, 1928.

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To Save the Tower of Pisa. Sci. and Inv., 15:1078, Apr. 1928.

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Making a Bird Bath in Concrete. Pop. Mec., p. 869, May 1928.
Racing Airplane Model. Pop. Sci. Mo., p. 82, May 1928.

WARNING AGAINST THE USE OF VACCINATION SHIELDS.

Surgeon-General H. S. Cumming of the United States Public Health Service has recently issued a warning against the use of any sort of vaccination shield or dressing, either at the time of or following vaccination against smallpox.

The Public Health Service has conducted studies extending over several years, which show that shields or dressings applied to a vaccination are a cause of severe "takes" and delay healing. The investigations have also shown that such dressings produce conditions in the wound which are favorable for the development of tetanus, or lockjaw, which is an occasional complication of vaccination. Lockjaw, it is pointed out, is caused by accidental contamination of the vaccination with tetanus germs which live in soil, dirt, dust, etc.

The Surgeon-General advises that no covering should be supplied to the vaccination. When this advice is observed, and a small, proper type of insertion has been employed, it is pointed out that the vaccinated spot will usually retain its natural covering, the skin itself, and in most cases develop a dry scab without having become an open sore at any time. Should an open sore develop, as occasionally happens through injury, an antiseptic dressing may be applied for a few days. Several layers of gauze pinned to the inside of a loose-fitting sleeve is perhaps best for this purpose. If the dressing is attached to the arm it should be large and the adhesive strips applied loosely and as far from the vaccinated site as possible.

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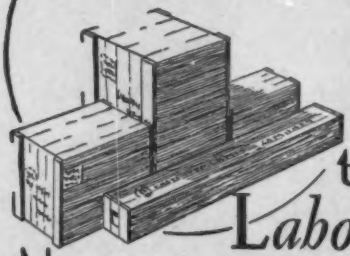

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